University of Alberta

# Assessing the Impacts of Complexity in Stated Preference Methods

*By*

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# 1.0 Introduction

In the past, forest management concentrated on development and sustained timber yields (McFarlane and, Boxall 2000). However, as noted by various authors (McFarlane and Boxall, 2000, Parkins et al. 2001 and Duinker, 1998, Beckley and Korber, 1996) societies' values are shifting from anthropocentric views towards more biocentric ways of thinking. Greater knowledge of environmental issues has spurred awareness among the public that forests are not only valuable for the market goods produced and the employment provided but also for the animal and plant life supported by complex ecosystems (Boxall and McFarlane, 2000). Therefore, it behooves forest managers to balance a multitude of objectives, which include use values (timber, recreation) and passive use values (endangered wildlife). The later represents goods that are more difficult to define in terms of a market value leaving them vulnerable to provision in suboptimal quantities. In order to gain a sense of these passive use values hypothetical markets are employed most commonly in the form of contingent valuation and choice experiment methods. In this study, values associated with forest management are elicited from the public using a choice experiment format. The choice experiment presents respondents with different "states of the world" which vary in terms of a series of descriptive attributes one of which is a price or cost attribute. Respondents are required to select their most preferred option by trading off attributes across alternative states of the world.

The ultimate purpose of conducting choice experiments is to determine welfare measures for changes in non-market environmental goods. The models produce output that can inform policy (Bennett and Adamowicz, 2001). However, in order for model results to be useful, biases must be accounted for and removed or reduced. In particular problems can arise when the choice experiment is too complex for respondents to reveal their preferences. The challenge for researchers is to balance the ability of respondents to trade-off attributes with the statistical efficiency of the experimental design. The greater the number of attributes, alternatives and tasks the greater the potential for more accurate results based on well specified choice set, however, if the complexities of the tasks exceed the cognitive abilities of participants the potential exists for even less accuracy in the estimation of preferences as respondents revert to heuristic strategies, abandon the task or make a random selection.

### 1.1 Assumptions Underling Respondent Decision making in Choice Modeling

Decision makers are often assumed to be perfect full information processors. It is assumed that they are completely aware of their preferences and are able to flawlessly and doubtlessly order alternatives using these preferences. However, the reality is less impressive, especially when goods or alternatives are unfamiliar or have an emotional context (Luce, 1998). Decisions involving environmental goods could be considered challenging due to their uniqueness in a decision making context. The nature of these goods does not lend itself to a market structure. Thus, respondents are not used to evaluating attributes of these goods and as a result have poorly defined preferences. Participants may experience difficulty with choices as they posses a threshold of ability to process information (Jacoby et al. 1974).

Selections made by participants are assumed by analysts to be based on a careful weighing of all the attributes between alternatives in a particular choice task. As it is impossible to have all desirable levels of all attributes, respondents are required to determine what levels of certain attributes they would be willing to give up in order to gain more of other attributes when selecting an alternative. It is from this assumption that estimates of marginal rates of substitution and welfare measures are made. If the choices are not made in this manner but are random, or based on heuristics, then estimated marginal rates of substitution have little meaning to policy makers or resource managers.

It is assumed that the decision maker is not influenced by the context in which the choice task is set. Thus, choices are made independent of outside cues and are based solely on the attributes of each alternative. This assumption is necessary because the desirability of an alternative is defined by its attributes. If decisions are based on some other factor, choice models may not accurately reveal respondent preferences.

### 1.2 Study Objectives

The overriding objective of this thesis is to explore issues of complexity in choice experiments. If the purpose of determining values for environmental goods is to eventually advise and influence policy then it is important to assure that those values are based on accurately elicited preferences. In placing too much emphasis on assumptions of perfect information processing, we risk making predictions and recommendations that are biased and inaccurate. Thus, this thesis attempts to provide advancement on two fronts:

- To examine the phenomenon called status quo bias: a commonly recognized bias in choice experiments in which respondents are compelled to select the current situation over other alternatives all else held constant. We consider whether heterogeneity in respondent ability and choice set complexity influence selection of the status quo option.
- To investigate whether specific choice task design elements increase complexity and response error variances. Systematic changes in choice task characteristics and context are included in the design of six different choice sets in an effort to determine whether varying levels of complexity influence the choices made by respondents.

### 1.3 Data

This thesis uses three separate choice experiment data sets:

- Shapansky (2002) conducted a survey of people living in and around Meadow Lake Saskatchewan. The survey included an attitude section that collected information on feelings toward forests, opinions on forest management and ranking of threats to forests. The survey also incorporated a choice experiment, which included seven attributes; moose population levels, special species population (caribou) levels, forest age class, recreation restrictions, protected areas, jobs and taxes. This survey became the basis for a second survey that was administered for the completion of the present thesis. In the provincial versus local case study in chapter 3 these data represent the local population.
- The second data set discussed in this thesis is the data that were collected by the author in 2003. The sample was a random sample of residents of the province of Saskatchewan. The experimental design involved systematically varying the structure (number of attributes) and the context

(labeling of alternatives) of a choice experiment. The result was six different versions of the original choice experiment produced by Shapansky; seven attributes of varying levels with labeled alternatives ($L_7$), seven attributes of varying levels with unlabelled alternatives ($U_7$), five attributes of varying levels plus two attributes of constant levels with labeled alternatives ($L_{5+2}$), five attributes of varying levels plus two attributes of constant levels unlabelled ($U_{5+2}$), five attributes of varying levels with labeled alternatives ($L_5$) and five attributes of varying levels with unlabeled alternatives ($U_5$). These data were used in Chapters 3, 4 and 5. In Chapter 3 only $L_7$ was used as it is the base design used by Shapansky. Thus, it would be the most appropriate data set to use as a comparison with his results. In Chapter 4 data sets produced from the $L_7$ $L_{5+2}$ and $L_5$ were used. In Chapter 5 all versions ($L_7$, $U_7$, $L_{5+2}$, $U_{5+2}$, $L_5$ $U_5$) were used.

- In Chapter 4 a third data set is introduced. The data were collected in Alberta by Adamowicz et al. (1998) for a study that examined preferences for attributes of forest management concerning the endangered/threatened woodland caribou. This data set is unrelated to the previous data sets in that the design of the survey is not based on either of the previously mentioned studies. However, as it is a choice experiment with a similar design that explored passive use values it was deemed worthy to test various hypotheses set out in Chapter 4.

### 1.4 Thesis Organization

This thesis is organized in the following manner: In Chapter 2 a literature review explores some of the underlying theory and assumptions of environmental valuation. In Chapter 3 an in depth explanation and description is given of the data collected for this study. This chapter also presents a case study comparing the sample from the local population (Shapansky's 2000 data) to the sample collected for the provincial population (Moon's 2003 data). Chapter 4 presents a study in which the potential for variations in respondent characteristics and choice set complexities that affect status quo alternative selection is investigated. Chapter 5 considers the issue of task design and whether systematic changes in attribute number and alternative labels affect the unexplained variation in the utility function. The final chapter summarizes some of the key findings and suggests avenues for future research.

# 2.0 Literature Review

## 2.1 Introduction

What an individual or a society values cannot always be expressed through markets. Humans hold deep feelings for things that are not always tradable or even tangible. Implicitly all people in society recognize this. We see this expressed in terms such as "sentimental values" or "spiritual values". Therefore, it is necessary to quantify some values associated with goods that have historically unvalued in market economies. Without some method for determining a quantified economic value many non-market goods will be ignored in a system that relies on market values. Thus, stated preference methods have been devised that allow for the valuation of non-market goods.

In the environmental economics literature methods have been explored that enable researchers to elicit public preference for environmental values. Examples of these methods include the Contingent Valuation Method (CVM) and Choice Experiments (CE), which essentially utilize hypothetical markets in which respondents make trade-offs between income and other attributes for the provision of environmental goods and services. However, in order to implement a hypothetical market it is necessary to use some type of public involvement. Surveys are an inexpensive vehicle for setting up this market and relaying it to respondents. When creating choice experiment surveys, economists often rely on the development of statistical designs to generate scenarios that are used to elicit trade-offs. Unfortunately, a statistically efficient design may conflict with the cognitive capacity of the respondent. Thus, an important area of study is how complexity of the design affects repeated choices when they are used as a method for the valuation of environmental goods. It is important to ensure that respondents are able to reveal their preferences for levels of environmental attributes (forests in this thesis).

This chapter is a literature review of the areas affecting the elicitation of preferences in the public involvement process. The second section reviews non-market valuation. This is followed by a review of random utility theory, which is the standard structure for analyzing choice data. The remaining sections review decision making in the context of key assumptions in economic theory. This includes a review of some of the psychology literature regarding decision making. This chapter is concluded with a review of what the implications of violating these assumptions are in terms of economic analysis and policy recommendations.

## 2.2 Environmental Valuation

Public goods valuation presents a formidable challenge. The struggle is to come up with a theoretically sound method for valuing a good that lacks the necessary characteristics of exclusivity and rivalry held by a market good. In essence, true public goods lack the required property rights associated with private goods. However, truly public goods are rare, as often a public good possesses some aspects of a private good. An example is the scenery in a national park. The scenery is non-rival, but by ensuring that people pay an entrance fee at the park gates to enjoy that scenery, policy has created an element of excludability. Therefore, it is better to view the division of public and private goods as a spectrum as opposed to two categories. This example serves to highlight the crucial question of an individual's willingness to pay. The park may be charging a fee but how is it that a particular fee is chosen? Is it reflective of the actual willingness to pay for such scenery or the willingness to accept compensation should that scenery be altered in some way?

The forests of Canada are used and valued for a number of purposes. Turner et al. (1994) decompose the values of a forest into use values and non-use values. Use values are defined as direct use values (timber harvest and berry picking), indirect use values (hunting and carbon sinks). Non-use values could be considered as existence values (just knowing forests are alive) and bequest values (recreation for future generation). It is true that some use values such as timber can be given a market price and traded in a tradition market framework; however, many indirect use values and non-use values require ingenuous methods of determining values. With values concerning recreation or environmental services parallel markets can be considered as is done in determining travel costs or hedonic housing prices. One difficulty with these methods lies in their inability to capture bequest or existence values. Methods such as CVM and CE have been devised in an effort to include these non-use or passive use values.

Although somewhat difficult for classical economists to accept[1], stated preference methods are being acknowledged as feasible, theoretically sound methods for capturing the welfare measures associated with the provision of public goods. Stated preference methods are thought of by some as inferior because the individuals involved are not actually making an economic decision, as is the case in revealed preference studies. In other words actual market behavior is not observed. Stated preference studies rely on survey methods in which respondents make hypothetical selections. However these methods have recently been recognized as a legitimate and practical way of measuring the true value of environmental change.[2] A classic historical example occurred after the 1989 accident in which the Exxon Valdez oil tanker spilled 11 million gallons of oil into Prince William Sound. The Court of Appeals in the United States determined that passive use values should play a role in natural resource valuation. It was also revealed that the court felt that CVM was a reliable method for undertaking such a task (Smith, 2000). However, among economists the debate ensues and the focus on contingent valuation since 1989 has led to rigorous evaluation of the method.[3]

CVM and CE are the two prominent methods of stated preference. CVM was the original tool of non-market valuation in the 1960's and is still widely used today. In 1994, Adamowicz et al. introduced to resource valuation a method known as attribute based stated choice method (ABSCM) or simply choice experiments. This method has its origins in the transportation and marketing literatures. Complete and accurate descriptions of a change in an environmental good are paramount in both CVM and CE as both are describing a hypothetical change in an environmental good. Therefore, a rigorous design period is a pre-requisite in ensuring that appropriate descriptions of the good are created. Consultation with policy makers, academics and focus groups provide useful information, allowing researchers to capture the essential attributes. One of which must be a payment attribute described as a tax or bill. This allows estimation of welfare measures. Generally, CVM and CE differ in the method structure. CVM is a specific description of a positive (or negative) change in an environmental good, followed by a request for a participant to attach a monetary value to having the change occur (or not occur) (Mitchell and Carson, 1989). CE is constructed by selecting attributes with various levels of provision and creating several combinations of these attributes and levels to describe potential alternatives (usually 2 or 3) to the current situation. The premise of the CE requires respondents to make selections of a preferred alternative (policy or good) by trading off attributes over several different choice tasks.

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[1] Jerry Hausman once said in a Business Week interview "Environmental Economics is to Economics as Military Music is to Music"( Smith, 2000).

[2] Work by Haener et al. (2001) finds that a well specified stated preference survey may generate more reliable data then poorly specified revealed preference data.

[3] The many issues surrounding contingent valuation are beyond the scope of this thesis.

In describing change in an environmental good or service, Boxall et al. (1996) reveal that one advantage of the CE over CVM is that CE relies on the accurate and complete description of attributes of a situation as opposed to the situation itself. Providing a more complete and in depth description of possible attribute trade-offs among alternatives may facilitate improved preference elicitation (Adamowicz et al. 1998). The method allows researchers the opportunity to present a sample of possible situations based on combination of different levels of the attributes. With the CE method respondents make decisions over an array of possible events (Boxall et al., 1996). It is possible to gain multi-attribute information with CVM. However, as Adamowicz et al. (1998) point out such a large number would be required that difficulties in the design and administration would arise. With less emphasis on the description of a specific situational change and a greater focus on a set of choice situations, CE more efficiently allows for a broader representation of preferences.

In concentrating on the features of environmental issues as opposed to the situation as a whole, the CE would appear to embody several advantages over CVM in situations, which attributes are important or alternatives exist. This is particularly true when there is interest in valuing a specific attribute. Situations in which this is the case may involve management or damage cases. In terms of resource management it is unlikely that decisions are made in the context of the entire resource, but in relation to changing levels of attributes and their interactions within the resource (Hanley et al. 1998). This is also true when damage has occurred to an environmental resource. It may be more realistic to determine values of attributes as opposed to the monetary value of the change to the entire resource.

## 2.3 Conceptual Background: Random Utility Theory

The foundational theory behind stated preference analysis is random utility theory. Central to this theory is the assumption an individual's ($n$) selection of an option from a set of alternatives represents a utility maximizing choice. Relevant to the derived utility from the selection of an alternative is the attributes of which the alternative is comprised. This utility can be expressed as $U_{nj} = U(X_{nj})$ where X is the vector of attributes in an alternative. $U_{nj}$ will be chosen if $U_{nj} > U_{ni}$ for all $j \neq i$. When studying the choice made by a decision-maker, the researcher will have knowledge of some of the attributes $(X_{jn})$ and some of the decision maker's characteristics $(A_n)$. This can be expressed as:

$$V_{nj} = V(X_{nj}, A_n) \tag{2.1}$$

However, the analyst cannot possibly know all of the details of the choice or decision-maker $(U_{nj} \neq V_{nj})$. Therefore, utility must be distilled into a systematic component $(V_{nj})$ and a random component $(\varepsilon_{nj})$. Ben-Akiva and Lerman (1985)[4] list the two potential sources of this stochastic component as measurement errors and instrumental variables. It is the distribution of this random component that underlies the derivation of different types of choice models (Train, 2002). Most commonly used, the conditional logit model has a specified distribution that is iid (independently and identically distributed) Type I extreme value. This implies that the error variances are not correlated among alternatives and that they do not differ. However this may be restrictive, as often alternatives will have correlated errors. By specifying alternate distributions more flexible choice models may be derived.

In the basic choice model utility may be represented as:

$$U_{nj} = V(X_{nj}, A_n) + \varepsilon_{nj} \tag{2.2}$$

---

[4] This was cited by Ben-Akiva and Lerman from a paper by Manski in 1973.

The probability that a survey respondent $(n)$ will choose option $j$ over option $i$ in choice set task $C$ is given by:

$$\Pr(j|C) = \Pr(V_{nj} + \varepsilon_{nj} > V_{ni} + \varepsilon_{ni} i \neq j, j \in C) \tag{2.3}$$

If utility is specified to be linear in the parameters, then $V_{nj}$ can be defined as $V_{nj} = \beta_q X_j$ where $X$ is a vector of $q$ attributes associated with alternative $j$ and $\beta$ is a coefficient vector. McFadden (1974) shows that the probability of choosing alternative $j$ becomes:

$$\Pr(j) = \frac{e^{\mu\beta X_j}}{\sum_{j \in C} e^{\mu\beta X_i}} \tag{2.4}$$

where $\mu$ represents the scale parameter. In a single data set the scale parameter is not identifiable and assumed to equal 1.0.

## 2.4 Decision making: Assumptions in Economic Theory

Stated preference is described by Adamowicz et al. (2002) as a methodology which draws upon studies of economic theory, econometrics and the psychology of survey design. Added to this list could be a sub-discipline of psychology known as human decision making theory. Over the last half-century economists and psychologists have begun to take notice of each other's research.

The assumption of rational choice, which underlies utility theory, is the foundation of the study of microeconomics. The rational decision maker is assumed to posses an almost divine ability to process and organize information concerning choice alternatives, while, being aware of their stable and well-formed set of preferences, which is used to make an optimal utility maximizing choice. In the 1950's with the work of researchers such as Simon (1955) the literature began to reveal awareness that the assumption was too restrictive in that it could not possibly encompass the complexities of the human decision making process. Such restrictiveness creates an unstable foundation for which to base the analysis of individuals and firms. Simon's (1955) early observation that psychology and economics might draw upon one another in an attempt to retain focus has become a reality with behavioral economics and human decision theory which have splintered from traditional economics and psychology.

Central to decision making is the act of "making trade-offs" among the various aspects of the available alternatives. This involves understanding that it is not possible to enjoy all goods without limit. In our daily life few of us actually consider all of the potential trade-offs in our choices; sometimes we make our decisions without really weighing the options or considering consequences. However, at other times lengthy thought and deliberation is necessary. These are often large difficult decisions with many aspects to consider. Utility theory is less concerned with what processes underlie decision making and more concerned with what decisions have been made. Three main assumptions are made regarding trade-off elicitation methods; respondents are perfect information processors, respondents make consistent choices when they evaluate alternatives by trading off attributes, and decisions are made independently of the context of the alternatives or structure of choice tasks.

### *2.4.1 Assumption 1: Complete, Transitive Preferences*

At the core of microeconomic theory lies the trade-off among bundles of goods by a consumer in order to achieve the ultimate goal of maximizing utility. This consumer, who is assumed to be well aware of his or her preferences, will equate marginal utilities upon which a balance is achieved within their budget constraint. Among other assumptions that underlie consumer preference theory is the assumption that consumer preferences are complete and transitive. Completeness assumes that when consumers are faced with a trade-off they will be sure that they prefer A to B or B to A or that they are indifferent (the decision could be made with a coin toss) (Binger and Hoffman, 1998). Transitivity assumes that based on their preferences decision makers will make consistent choices, when A is preferred to B and B is preferred to C then A is also preferred to C (Binger and Hoffman, 1998). When dealing with simple consumer items, people may have little difficulty dealing with these trade-offs. It may not be necessary to seriously consider the attributes of each option. A choice is simply made indicating that for smaller market items such as breakfast cereal consumers have well defined ordered preferences. Thus, an important assumption in stated choice methods is the ability of the respondent to behave as a precise, infinite information processor. Therefore, theory suggests that complexity of the choice task will not affect the response of the decision maker.

Researchers have explored uncertainty in decision making in terms of the barrier it creates for individuals in revealing their true preferences by selecting their most preferred alternatives. DePalma et al. (1994) hypothesized that as decision makers are confronted with increasing amounts of information that they begin to simplify their decision process. This arises from Simon (1955) who offered the idea that decision makers obtain a level of utility that is below that which is optimal. De Palma et al. (1994) modeled a decision maker who reduces the burden of maximizing utility from one of comparing all potential consumption bundles to one in which marginal utilities are approximated and evaluated. However, it must be allowed that the individual would be likely to make errors in comparing marginal utilities creating a disparity between actual and apparent utilities. DePalma et al. (1994) attributed this difference in real and perceived utility to the decision maker's ability. It is found that an increase in ability decreases the variance of marginal probabilities around improved alternatives. The most poignant finding by DePalma et al. (1994) was that despite identical tastes and information preferences, actual choices will vary widely.

Swait and Adamowicz (2001a) extended work completed by DePalma et al. (1994). They use DePalma et al.'s theoretical base and adding an empirical measure as a way of testing whether survey respondents dealing with an increase in the complexity of problems will display a decrease in their ability to make trade-offs among alternatives. This research allows for the relaxation of the assumption of the consumers' ability to make rational choices by creating a measure known as entropy to account for complexity in order to avoid bias in analysis of elasticities and economic welfare measures.

Heiner (1983) took the approach that individual ability is rooted in ability to choose. However, Heiner (1983) hypothesized that there exists a competence difficulty gap (C-D gap). Heiner (1983) proposed that this gap is unaccounted for in traditional choice theory and that the presence of the gap actually increases the predictability of behavior as it leads to behavior that is guided by decision rules. This was tested empirically by Mazzotta and Opaluch (1995), who found statistical evidence for the existence of a C-D gap. Their results, however, did not point to decision rules in which a dominant strategy is employed. It revealed that respondents may be employing mixed strategies, thus failing to support Heiner's hypothesis that the use of decision rules leads to increased predictability (Mazzotta and Opaluch 1995).

The ability of humans to make consistent choices is influenced by their ability to process information. Jacoby et al. (1974) hypothesized that we possess only finite capabilities for understanding and using information leaving us susceptible to an overload of information. This causes a decline in decision efficiency. Keller and Stalin (1987) proposed that the effect of information on decision making is actually composed of two components: quantity and quality. They find results that are consistent with Jacoby et al. (1974) in that an increase in information decreases the ability to make consistent decisions. However, the results indicate that with an increase in information there is at first an increase in decision efficiency followed by a decrease once the amount of information has exceeded some threshold. In terms of quality, results revealed that increases in quality of information increased choice effectiveness. This may indicate that when researchers devise decision making tasks, it is important that the attributes are poignant in terms of information provided, yet limited in number.

It may be unrealistic to assume that people participating in stated preference studies posses clearly ordered preferences. Goods respondents are asked to consider in a survey situation may be such that a respondent has had little exposure, leaving them with a reduced ability to convert new information into decisions. Thus, choices by respondents may be made with uncertainty rather than clarity regarding individual preferences.

### ***2.4.2 Assumption 2: Compensatory Decision making***

Economic consumer preference theory assumes that individuals have continuous preferences (Binger and Hoffman, 1998). In order to estimate marginal rates of substitution among attributes, this assumption is required to ensure smooth indifference curves. When a consumer continually prefers an alternative that has even the slightest improvement in a particular attribute to all other alternatives, despite increases in other attribute levels, preferences violate the presumption of unlimited substitutability. Therefore, an individual who behaves in a non-compensatory manor is violating the assumption that among a set of attributes an improvement in some will be able to compensate for losses in others (Ryan and Bate, 2001). In other words, the respondent does not make trade-offs among attributes between alternatives.

The branch of psychology, Human Decision Theory, is deeply concerned with what can make some trade-offs more difficult than others and how humans deal with these trade-offs when they find them difficult. Difficulty may arise for respondents when the attributes of alternatives they are asked to evaluate and choose between are fundamentally different. In a health application, Beattie and Barlas (2001) classify these attributes into three categories based on cluster analysis of their attributes: commodities (surgical equipment), non-commodities (pain and suffering) and currencies (dollars). Subjects in their experiments were found to have profound difficulties trading off commodities and currencies with non-commodities. Support for the difficulty in particular pairings of attribute types is also found in Luce (1998), who believes that decision makers may experience difficulties making trade-offs when particular attribute pairs involve emotions. Luce (1998) provided the example that a decision maker who is purchasing a car may have more trouble dealing with the trade-off between purchase price and safety than purchase price and comfort. Of course they acknowledge that this relationship may be directional in that the emotional involvement comes from having to trade-off price for safety rather than safety for price. Therefore, it may be that within the pair of attributes a consumer would find safety to be the more emotionally difficult attribute to trade (Luce, 1998).

Certain beliefs may limit respondent willingness to engage in compensatory decision making. These may range from cultural or religious convictions to moral and ethical ideas about the inherent rights and necessities of nature (Rosenberger et al. 2003). Particularly in environmental stated preference studies, there may be reluctance among respondents to make trade-offs among certain attributes. Individuals may be inclined to always make selections with a particular attribute such as increased wildlife or improved habitat regardless of other changing attributes such as costs or jobs. Research by Rosenberger et al. (2003) found that individuals with strong environmental ethics standards showed a greater propensity towards displaying lexicographic preferences. However, this disposition was the only strong indicator of lexicographic preferences of numerous dispositions tested (including, among others, need for un-built places, modify environment to satisfy needs/desires and community orientation).

In an empirical study focusing on after hours health care, Scott (2002) revealed some evidence that dominant preferences result from complex choice experiments. They base these results on participant response to a question regarding a difficulty rating, respondent education and the version filled out by respondents. They found that those who filled out the second version were twice as likely to express dominant preference. In terms of a difficulty rating, they found that among those who indicated difficulty with the choice set but who had a university education lexicographic preferences where less prominent than for those with only a secondary education. Age was included as a potential explanatory variable but was not found to be significant.

Decision makers may not always behave as if one alternative may replace another based on different amounts of attribute levels. It may be that an individual truly has an unusually strong desire for a particular attribute. Alternately, it may be that the task overwhelms the decision maker leaving them searching for a coping strategy. Therefore, it is up to the researcher to be aware of the inadvertent reluctance of decision makers to make necessary trade-offs.

### *2.4.3 Assumption 3: Preference Independence from Task Structure and Context*

As omnipotent optimizers, respondents are assumed to be immune to the complexity of choice sets in terms of structure and context. Common sense prevents complete submission to such an assumption. However, the literature fails to define these limits other than in general ways. The following two sections present evidence from the literature that suggests respondent choice consistency is affected by both the structure and context of the choice task.

#### *2.4.3.1 Characteristics of Complexity: Difficulty within the Structure of Choice Tasks*

The experimental examination of a complex choice can take on numerous forms. It has not yet been determined in the marketing, psychology or economics literature what defines a complex decision. In economics, those studying decision making in the form of CE adhere to several loosely defined rules of thumb such as general boundaries to the number of attributes (4 to 5) and the number of levels (3 to 4) (Holmes and Adamowicz, 2003). Ideally, when respondents are given a choice task, their responses will reflect their true utility maximizing choice. However, if the complexity of the task or choice survey prohibits the respondent from making trade-offs among alternatives, the results will be biased. Therefore, it is paramount that research is completed that allows for a better understanding of the limits of complexity in terms of respondent ability to comprehend and complete choice tasks. The numbers of alternatives, attributes, attribute levels and choice tasks can characterize the complexity of CE. More subtle characteristics such as attractiveness and uniqueness may also influence the complexity of a choice task.

DeShazo and Fermo (2002) and Swait and Adamowicz (2001a) examined the effects of the number of alternatives on respondent decisions. The studies differed in that DeShazo and Fermo (2002) systematically varied the number of alternatives in two separate studies while Swait and Adamowicz (2001a) examined six previously completed choice experiments. DeShazo and Fermo (2002) tested between 2 and 7, and 6 and 9 alternatives, while Swait and Adamowicz (2001a) compared among 3 and 6 alternatives.

Both studies pointed to an increasing cognitive burden as alternatives increased. However, the results of DeShazo and Fermo (2002) indicated that as the number of alternatives increases the variance of the error term decreases initially and then began to increase as alternatives were added. This result indicates that the effect of complexity on consistency may be quadratic. This result is similar to findings by Keller and Staelin (1987) who found that in terms of decision effectiveness, increases in information are valuable until a limit is reached after which more information is detrimental. A potential explanation is that up to a threshold, as the number of alternatives is expanded respondents may find that a preferred alternative is more readily available. However, upon reaching this point complexity effects take over explaining the increase in error variance (DeShazo and Fermo, 2002).

DeShazo and Fermo (2002) and Mazzotta and Opaluch (1995) test the number of attributes that differ across alternatives. DeShazo and Fermo (2001) examined between 2 and 3 attributes that differed across alternatives in one data set and in another data set they test between 2 and 5 attributes that differed across alternatives. They found for both sets of data that the variance of the error term increased, indicating that the larger number of comparisons between alternatives is mentally more difficult for their respondents. Mazotta and Opaluch (1995) attempted to determine if respondents revert to specific heuristics when the number of attributes that differ across alternatives is increased from 2 to 6 attributes. They found that when they compared the number of different attributes between alternatives, differences were somewhat significant between 2 and 3 differences, very significant between 3 and 4 differences and not significant between differences of 4 and 5, or 5 and 6. This indicated that at lower levels respondents handle differences in attributes across alternatives. However, when the number of differences increases to a threshold, complexity effects become evident. Beyond a threshold complexity effects are no longer observed perhaps suggesting that respondents are handling complexity by devising simplification methods (Mazzotta and Opaluch, 1995). Aside from the number of attribute differences across alternatives, Dellart et al. (1999) found that differences in attribute levels may also affect consistency. They found that as price level differences increased, there was a decrease in choice consistency.

The number of choice tasks can influence the ability of the respondent to make consistent decisions. In designing choice experiments between 8 and 16 choice tasks are recommended as general guidelines in economic research (Holmes and Adamowicz, 2003). However other disciplines such as marketing typically use between 16 and 32 choice tasks, while psychologists have been known to administer hundreds of choice sets (Henser et al., 2001). Hensher et al. (2001) tested between 4 and 32 choice sets and found that 16 sets were sufficient for analysis. However, results could be improved with 24 and 32 choice sets, although improvements were marginal. The main concern with longer surveys is participant boredom and fatigue. However, Hensher et al. (2001) did not find evidence of this at 24 or 32 choice tasks.

#### *2.4.3.2 Context and Complexity: Difficulty with Choice Task Circumstance*

The situation an object is placed in can influence the perception one has of that item. For example, if a short person is standing next to a tall person they both appear to be extremes. However if a short person is standing with other even shorter people the former person appears tall. This also occurs when people are making choices. The options available will influence how other alternatives are viewed. Thus, the context of choice such as dominant or attractive alternatives can influence the choices actually made.

Previous research found that when alternatives are similar a choice situation of high conflict is created as opposed to a situation in which one alternative is exceptional. This can lead respondents to defer or opt out of the decision making process (Dhar, 1997 and Tversky and Shafir, 1992). Some research has suggested that common features of alternatives are cancelled and that attention is refocused on the remaining differing attributes (Houston and Sherman, 1995). Dhar and Sherman (1996) extend these results and demonstrate that difficulty can arise among the remaining unique attributes depending on whether they are considered good or bad. Choice sets containing unique "bad" attributes have been found to increase respondent preference for opting out of the decision. Bockenholt et al. (1991) provide support for these findings. The study attempted to reveal whether participants required extra information with similar or dissimilar degrees of attractiveness of alternatives. It was found that when the similarity of alternatives increased in choice alternatives more information was required in order to make a decision. Bockenholt et al. (1991) also found that when all of the alternatives in a choice task were deemed to be attractive, respondents required less information than when all alternatives were described as unattractive. An interpretation offered for this result is that people are willing to invest effort in closely examining alternatives in which neither outcome is attractive as the payoff is to choose the best possible outcome of a bad situation. Thus, utility would be increased whereas in a situation where both payoffs are considered good, little additional utility can be gained or is considered less important.

These findings reflect a behavior in which losses are weighted more than gains, a consistent finding in a number of economics studies (Kahnamann et al. 1990). Bockenholt et al. (1991) also investigated a participant's desire for additional information when making a choice. They found that when alternatives were similar without a dominating alternative people were more likely to request additional information. Moreover, when alternatives were unattractive the desire for additional information was higher than when attractive. Thus, sufficient evidence exists in the literature to suggest that increasingly similar alternatives are indicative of increasing complexity.

### 2.5 Decision-Maker Response to Complex Choice Situations

Payne et al. (1993) developed a framework for evaluating the decision strategies used by individuals when making complex decisions. It is assumed the desire of the individual is to use as little effort as required to reach a preferred result when solving a problem. The theory of the adaptive decision maker revolves around the idea that a decision maker determines how they will make a decision by weighing the effort required to achieve the desired accuracy using a particular strategy. This is dependent on the context of the choice task, therefore, it is imperative that the decision maker is able to adapt the decision making strategy in terms of required effort and desired accuracy. It can then be assumed that respondents may utilize numerous different strategies. Payne et al. (1993) report that the decision maker strategy is to employ a number of mental operations in the form of "IF (condition is) THEN (my strategy is)" type statements. It is thought that the selection of the decision strategy may be both a conscious choice as well as a learned dependency among the fundamentals of the task and the effort/accuracy of the decision strategy. Payne et al. (1993) assumed that the decision maker will choose a strategy that is both responsive and optimal.

Work summarized by Gigerenzer et al. (1999) suggests that decision makers ease the cognitive burden of evaluating large volumes of information by employing heuristics. Gigeranzer et al. (1999) diverge from earlier economic work by discrediting utility theory and arguing that humans do not contemplate decisions within the realm of probabilities and utilities, but instead use what they have termed as "fast and frugal" heuristics. Gigerenzer et al. (1999) argued that it is impossible for decision makers to commensurate supposedly priceless items such as friendship with common consumer goods. Instead it is hypothesized that humans use a number of decision making rules dependent on the decision making situation that they encounter. One particular example is the stopping rule known as "satisficing" in which the decision maker stops the search for alternatives when one is found that satisfies some predetermined criteria (Girgeranzer et al., 1999).

## 2.6 Implications for Environmental Valuation

Evidence presented in the previous section suggests assumptions that underlie environmental valuation are often violated in practice when using stated preference methods. Respondents behave less as the rational beings researchers expect and more as the human beings that they are when confronted with complex choices. If researchers employing discrete choice models do not recognize complexity effects, bias may be present in taste parameters resulting in inaccurate welfare measures. The following chapters of this thesis explore two topics involving complexity in choice experiments; behavioral response and task design.

When respondents are faced with difficult decisions the reaction may be reluctance to move away from the current situation. This phenomenon has been called the status quo bias (Samuelson and Zeckhauser, 1988). In many choice experiments the design is such that selection of the current situation or status quo alternative may reflect several potential reasons for that choice. Respondents may simply desire to retain what has been bestowed to them, an affinity that is potentially strengthened with difficult decisions. It is also possible that complexity leads respondents to express their lack of willingness or ability to make the essential trade-offs by "opting out" of the choice task with the selection of the status quo. Whatever the reason for selection of the current situation, the result is a violation of the assumption of compensatory decision making. Thus, indifference curves are no longer continuous leading to difficulties determining marginal rates of substitution. The status quo option may become more appealing at higher levels of complexity and this must be accounted for when analyzing choice results to ensure that proper recommendations are made regarding policy.

Changes in the structure and context of choice tasks may lead to significant changes in consistency of respondent choice (DeShazo and Fermo, 2002; Blamey et al. 2000). The effects of changes in complexity on respondent choice consistency can be determined (DeShazo and Fermo, 2002). DeShazo and Fermo (2002); Blamey et al. (2000) found, respectively, that changes in choice task characteristics (number of attributes) and context (whether alternatives are labeled) can significantly alter the variance of the error term, implying that some data sets or portions of data sets are "nosier" then others. Therefore, the design of choice tasks and choice sets is an important consideration in choice modeling. If analysts ignore complexity, statistical bias may be introduced to the estimates of taste parameters (Swait and Adamowicz, 2001a). Thus, failure to account for complexity may have implications for the predictive ability of discrete choice models (Swait and Adamowicz, 2001a).

# 3.0 Data, Methods and Case Study

This chapter presents a case study examining public opinions, attitudes, feelings and preferences of both local and provincial populations in Saskatchewan. The local data were collected by Shapansky et al. (2002). The provincial data were collected as part of the work for this thesis. Individuals living close to a forestry operation can be expected to have a different perspective then those who are removed from the situation. This may be due to dependence on the operation for jobs, recreation and in some cases sustenance. These differences may affect the welfare measures for the different groups, resulting in differences in policy recommendations for forest management based on public opinion.

## 3.1 Introduction

Despite the status of Saskatchewan as a primarily agricultural province, over half of the provincial land area (approximately 35.5 million hectares) is forested (Saskatchewan Forest Association, 2003). Primarily, the land is owned by the province (95%) while, remaining land is owned federally (3%) and privately (2%) (University of Saskatchewan, 2003). The substantial amount of public ownership necessitates the need for public involvement in deciding the direction of management of this land. In 1990, Mistik Forest Management was created by NorSask Forest Products (sawmill owner) and Miller Western (pulp mill owner) in order to plan the harvesting and reforestation of the NorSask Forest Management Licensing Agreement (Canadian Forest Service, 2001). A less overt goal of Mistik is to carry forth these responsibilities with the council of local communities. In this spirit Mistik consults with groups that include outfitters, trappers, First Nation's elders, traditional forest users and businesses (Canadian Forest Service, 2001). However, public participation is a relatively new mandate in the forest industry. Therefore, Mistik allocated research money for studying methods of public participation.

To address this, Shapansky et al. (2002) collected data concerning the local public's feelings, attitudes and preferences concerning forest management. A concern for the management company is the preferences of those who may not live in the area but are residents of the province. As the province largely owns the forest resource, residents from all over the province should have a right to be considered in the involvement process.

Thus, Mistik invested in a study of local and provincial preferences over forest management options.

### 3.2 Survey Design and Development

The basis of the design of the Forest Management in Saskatchewan survey for this thesis comes from the earlier work of Shapansky et al. (2002).[5] In order to complete his work regarding the stability of preferences, Shapansky et al. (2002) worked closely with people who live in the Northwestern Forest of Saskatchewan. He was able to assemble a core group, which advised him on the design of the choice experiment portion of the survey. Through a series of meetings Shapansky et al. (2002), in consultation with this core group, was able to refine and determine the most important attributes and attribute levels.[6] The attributes selected were; number of moose, number of caribou, Forest Age (percentage of old growth), recreation and forest access, protected areas, forestry employment and provincial household income tax. Based on interviews with Saskatchewan Environment and Resource Management (SERM) and Mistik employees, and a review of the literature and local knowledge, the base case and various possible levels were selected for all attributes (Shapansky et al. 2002). Levels were selected based on criteria such as historical levels, minimum necessary levels and ecologically "healthy" levels (Table 3.1).[7]

**Table 3.1: Attributes and levels used in Forest Management in Saskatchewan provincial and local choice experiments**

| Attribute | Level |
|---|---|
| *Moose* | 2,000; 6,000; **7500**[a]; 14000 |
| *Caribou* | 50; **300 to 500**; 600; 1,600 |
| *Forest Age (% old)* | Less then current amount; **Current Amount**; More than; considerably more than |
| *Recreation Restrictions and Forest Access* | (1)**Two weeled drive (2WD) access**; (2)4WD access; (3) ATV required and (4)Foot Access only |
| *Protected Areas* | **Current Amount**; 5%; 10% and 15% above Current Amount |
| *Forestry Employment* | Jobs range between 270 and 860 **(Current = 600)** |
| *Provincial Household Income Tax Changes* | **(Current = No Change)** Taxes ranged between a decrease of $120 to an increase of $205 year |

[a] bold indicates status quo level

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[5] A copy of the survey designed for this thesis is available in Appendix A.

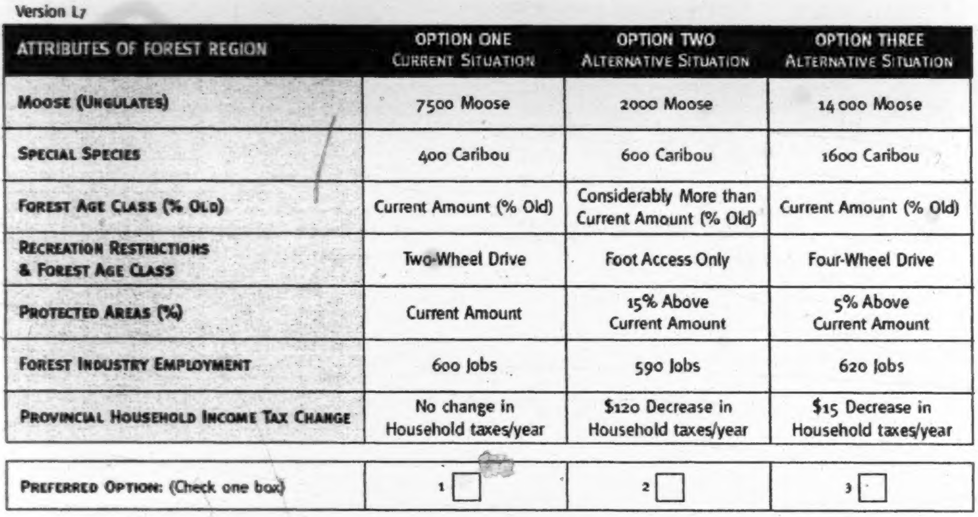
[6] The details of the meetings and design are available in Shapansky (2002).

[7] A complete description of the attributes and levels is available in Appendix A.

Using Shapansky et al. (2002) the attributes and levels a $(4^7) \times (4^7)$ orthogonal main effects design was constructed which allowed for 64 choice tasks blocked into four versions of 16 choice tasks. Feedback from participants indicated that some attribute levels were unrealistic. Shapansky et al. (2002) modified the design by adding a small degree of correlation (10%) to the attributes of protected areas, jobs and taxes.

Each task in Shapansky's choice experiment consisted of 7 attributes with 4 varying levels (Table 3.1) and three labeled alternatives; a present situation alternative (the status quo) and two possible alternate scenarios. Individuals were instructed to choose the one alternative that they liked the best or disliked the least. Participants were asked to consider all choice sets as independent and unrelated to all other choice sets. By altering the choice tasks presented by Shapansky (2002) it became possible to examine the effects of complexity in terms of choice task structure and labeling effects. For the purpose of this study the original survey designed by Shapansky (2002) was used as the base design, while five additional variations were also devised.

**Figure 3.1: Example of a choice task used in survey version $L_7$**



Version L7

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| Moose (Ungulates) | 7500 Moose | 2000 Moose | 14 000 Moose |
| Special Species | 400 Caribou | 600 Caribou | 1600 Caribou |
| Forest Age Class (% Old) | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| Recreation Restrictions & Forest Age Class | Two-Wheel Drive | Foot Access Only | Four-Wheel Drive |
| Protected Areas (%) | Current Amount | 15% Above Current Amount | 5% Above Current Amount |
| Forest Industry Employment | 600 Jobs | 590 Jobs | 620 Jobs |
| Provincial Household Income Tax Change | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| Preferred Option: (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

A total of six versions of the survey were designed to test for effects resulting from number of attributes and labels (Table 3.2). We began with attributes. The attribute differences in our survey would be: 7 attributes with levels allowed to vary for all attributes, 5 attributes with levels allowed to vary plus two attributes with the levels held constant and 5 attributes with levels allowed to vary for all attributes. Thus, describing our attribute variations as number of attributes is not particularly accurate. While one question specifically related to attribute number (7 attributes with levels allowed to vary versus 5 attributes with levels allowed to vary) another was related to the most appropriate way to present fewer attributes (5 attributes allowed to vary versus 5 attributes allowed to vary plus 2 held constant). This question arose following a review of work by DeShazo and Fermo (2002) who were, also, interested in testing the complexity effects related to numbers of attributes. However, in order to test for these effects DeShazo and Fermo, (2002) simply dropped two relevant attributes. We felt that a better way might be to instead hold the levels of the dropped attributes constant. This allows the researcher to still include all important attributes so that the task is fully described but it reduces the number of trade-offs required on the part of the respondent. For instance, with 7 attributes respondents must make trade-offs across 3 alternatives based on 7 attributes with changing levels whereas, if two are held constant respondents are still aware of the 2 attributes but do not need to evaluate tradeoffs across alternatives for those attributes. Recreation was selected as an attribute to drop and hold constant because Shapansky's study revealed that this attribute yielded insignificant results. The presence of forest age as a "preservation attribute" provided the justification for selecting Protected Areas as the second attribute to eliminate and remain fixed.

We then attempted to incorporate label changes into our design. In order to determine if the results are affected by alternative labels, we created three versions (half of the six final versions) of the survey based on labels. In all six survey versions the alternatives were labeled as: Option 1, Option 2 and Option 3. In half of the surveys ($L_7$, $L_{5+2}$, $L_5$ in Table 3.2) a sub label was also included. This identified the first option as the Current Situation (the status quo option) and the second and third options as Alternative Situations. For each attribute variation (7, 5+2 and 5) a labeled ($L_7$, $L_{5+2}$ $L_5$) and unlabeled ($U_7$, $U_{5+2}$, $U_5$) version was created. The final six different survey versions are detailed in Table 3.2. Figure 3.1 is an example of a choice task from version $L_7$.[8]

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[8] For an example of a choice task for versions $L_7$, $U_7$, $L_{5+2}$, $U_{5+2}$, $L_5$, and $U_5$ see Appendix B.

**Table 3.2: Summary description of the survey versions ($L_7$, $U_7$, $L_{5+2}$, $U_{5+2}$, $L_5$, and $U_5$)**

| Attribute Number | Status Quo Labeled | Status Quo Unlabeled |
|---|---|---|
| 7 attributes<br>All levels allowed to vary | $L_7$ | $U_7$ |
| 5 attributes with levels allowed to vary: 2 levels (protected areas and recreation) held constant | $L_{5+2}$ | $U_{5+2}$ |
| 5 attributes with levels allowed to vary: protected areas and recreation deleted | $L_5$ | $U_5$ |

### 3.3 Surveying Method and Response Rates

The survey was conducted through the mail and followed the procedure outlined by Dillman (2000) for conducting a mail survey. This "Dillman Method" consists of a series of contacts with respondents. This along with a variety of suggestions concerning response inducement techniques were taken into consideration in this study. The lack of one "sure fire" technique necessitates methodology that incorporates numerous tools (incentives, personalization) and contacts to increase response rates.

Participants were gathered using a telephone recruitment conducted by Criterion Research of Edmonton, Alberta. The sample was drawn from all telephone numbers of the Province of Saskatchewan. Respondents were residents of Saskatchewan who were over the age of 18. In order to assure that respondents were not continually the oldest in the household, most educated or a particular gender, the respondent with the most recent birthday was requested.

The call placed by Criterion Research was the first contact with potential participants. At this time it was identified to participants who was conducting the research, what the research was about, when the survey would be sent and approximately how much of a time commitment was involved. If the person agreed to participate a verbal agreement was made and all the relevant personal information was taken. They were then advised that the survey would arrive in the mail within 14 days.

A cover letter was prepared which included description of the research and an explanation of the importance of the research for residents of Saskatchewan. By connecting the research back to participants it was hoped that they would understand the importance of their participation. Confidentiality was also assured to allay any fears of providing personal information. Upon receiving the information of those who had agreed to participate, cover letters were printed with the names of the participant in the greeting and signed personally using a blue pen by the lead researcher. Respondents were given a deadline of April 30, 2003 to complete the survey. A deadline was decided on as it lets respondents know that the timeline for participating in the project is not infinite and projects a feeling of urgency.

Included in the first mail out of the survey package was a one dollar Tim Horton's gift certificate. An obligation arises when an incentive is received before the work is completed leaving a feeling of guilt should the incentive be kept without completing the survey.[9] The size of the token has little to do with effectiveness in terms of response. A second incentive used was the postage paid envelope with actual postage stamps. Instead of having the response envelope metered, this approach shows effort on the researcher's part and relays a sense of value. It is more difficult for a person to discard or reuse an envelope stamped with real postage stamps rather than the usual prepaid envelope received with bills. The other advantage is that the researcher has differentiated their package from other government or corporate mail.

The third contact was in the form of a reminder postcard mailed two weeks after the first survey package. The postcard reminded respondents that they had agreed to do the survey and that they should complete it that day if possible. Again the importance of the survey was reiterated. The postcard was picturesque in the hope that respondents would hold onto it and continually remind themselves to respond. The postcard was also personally signed in blue ink by the lead researcher.

The fourth and final contact was a second complete survey package. A cover letter was included, printed on a different university letterhead to indicate that it was a different letter. The letter again indicated the purpose and importance of the survey. The letter indicated a new deadline but strongly encouraged participants to complete the work that day. A postage paid envelope was included but the gift certificate incentive was not included again. Dillman (2000) recommends a fifth contact however budget and time restrictions prevented any more attempts.

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[9] This was observed in one case in the course of this survey. A respondent returned their gift certificate with an incomplete survey and a note indicating that they could not complete the work.

Overall and within each survey version group the response rates are comparable to those achieved by Dillman using the methods described in his book. Despite the variations in difficulty of the different versions ($L_7$, $U_7$, $L_{5+2}$, $U_{5+2}$, $L_5$, $U_5$) no pattern emerges in terms of a higher or lower response rate (Table 3.3). The overall response rate of 62.8% is comparable to the 63% obtained by Shapansky et al. (2001) using the same mail out survey. The response rate is also comparable to the 65% response received by Adamowicz et al. (1998), who conducted a similar choice experiment in Edmonton, Alberta Canada using the method of repeated contacts.

**Table 3.3: Response rates for individual groups ($L_7$, $U_7$, $L_{5+2}$, $U_{5+2}$, $L_5$, $U_5$) and overall combined response rate**[10]

| Group | Total Number of Respondents | Number of Responses | Response Rate |
|---|---|---|---|
| $L_7$ | 100 | 60 | 60% |
| $U_7$ | 100 | 66 | 66% |
| $L_{5+2}$ | 100 | 65 | 65% |
| $U_{5+2}$ | 100 | 60 | 60% |
| $L_5$ | 100 | 67 | 67% |
| $U_5$ | 100 | 59 | 59% |
| Total Response Rate | 600 | 377 | 62.8% |

### 3.3.1 Demographic Characteristics of Respondents

Demographic information was collected on respondent age, education, income, gender, organization membership and industry involvement (Table 3.4). Provincial statistics obtained from 2001 census results provide a useful point for comparison.[11]Overall the demographic characteristics of the survey respondents are slightly different than those of the Province of Saskatchewan. On average the survey respondents were six years older than the average provincial resident. However, our sample is truncated at 18 years old so this result is not that surprising. Although statistically significant differences were not observed between any of the group's ages, it was found that the oldest mean age occurred in group $U_5$ (48 years) and the youngest mean age occurred in group $L_7$ (43 years). In terms of gender the groups showed for the most part higher numbers of women than men. The exception was Group $U_7$ with 51% men and 49% women. However, Group $U_7$ was the most equally balanced and most representative in terms of the provincial percentages of men and women. The median education level is slightly higher for the survey group total than the province. An education level of five translates to having college or technical school, which indicates that the median education level for all of the groups is approximately fourteen to fifteen years.[12] The incomes are difficult to compare to the provincial medians as the levels requested in the survey indicate a range. Overall the groups indicate a median income range of $50 000 to $59 000 which is slightly higher than the provincial median of $49 264. When comparing the mean incomes for each group, Group $U_5$ distinguished itself as the highest income ($59 600) and Group $U_{5+2}$ is noted as the lowest ($49 500). These groups were found to have statistically significant different incomes when compared at a 10% confidence level. Natural Resource Dependency was 17.5% overall. Groups $L_7$ and $U_{5+2}$ were the most dependent on Natural Resource industries while Group $L_{5+2}$ was the lowest. Membership in environmental organizations was low overall with only 2.38% participating in such groups. At 20% participation, Group $L_{5+2}$ was most involved in Natural History Organizations. Approximately equal involvement in Hunting and Fishing Organizations was evident. Overall the demographic characteristics of the six groups are similar to each other with no group distinguishing itself in all characteristics.

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[10] The response rates indicate surveys returned in which some attempt was made to complete the survey. Surveys that were returned blank or with a note explaining they no longer wished to participate were not included.

[11] The demographic results are listed for each group ($L_7$, $U_7$, $L_{5+2}$, $U_{5+2}$, $L_5$, $U_5$) individually for completeness. T-tests were preformed between each group to insure that none of the groups reveal obvious differences among socio-economic characteristics. Each individual group is not discussed in detail in the text.

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[12] Technical programs are often between 2 and 3 years.

**Table 3.4: Some characteristics of individuals who responded to the Forest Management in Saskatchewan 2003 survey and of the residents of Saskatchewan.**

| Demographic characteristic | Provincial level | Version of survey | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | $L_7$ | $U_7$ | $L_{5+2}$ | $U_{5+2}$ | $L_5$ | $U_5$ | |
| Number of respondents | | 60 | 66 | 65 | 60 | 67 | 59 | 377 |
| Mean (SD) age | 39.8 | 43.8 (15.3) | 46 (14.7) | 45.9 (13.8) | 47.1 (13.4) | 45.6 (14.7) | 48.6 (14.0) | 46.1 (14.4) |
| Median age | | 43 | 46 | 46 | 49 | 45 | 48 | 46 |
| Percent female[a] | 50.8 | 58 | 49 | 57 | 57 | 55 | 56 | 205 |
| Median Education (SD) | 4[b] | 5 (1.6) | 6 (1.8) | 5 (1.8) | 5 (1.7) | 5 (1.9) | 5 (1.5) | 5 (1.7) |
| Mean household income (SD) in $1000's | 49.1[c] | 58.7 (24.1) | 54.1 (25.7) | 54.1 (23.3) | 49.5 (22.5) | 55 (24.2) | 59.6 (22.5) | 55 (24.1) |
| Median household income | | 6[d] | 5 | 6 | 5 | 6 | 6 | 6 |
| Membership in an environmental group (% respondents) | NA[e] | 1 (1.7%) | 5 (7.6%) | 1 (1.53%0 | 1 (1.7%) | 0 (0%) | 1 (1.69%) | 9 (2.38%) |
| Membership in a natural history, birdwatching etc. organization (% respondents) | NA | 10(16.6%) | 7(10.6%) | 13(20%) | 9(15%) | 3(4.5%) | 3(5.08%) | 45 (11.9%) |
| Membership in hunting/fishing organizations (% respondents) | NA | 4 (6.7%) | 8 (12.12%) | 6(9.23%) | 6 (10%) | 6 (9%) | 5 (8.5%) | 35 (10.8%) |
| Dependent on oil & gas, forestry, mining etc. (number of respondents) | NA | 14 (23.3%) | 10 (15.2%) | 6 (9.23%) | 14 (23.3%) | 9 (13.4%) | 13 (22.0%) | 66 (17.5%) |

[a] The percentage of females in Saskatchewan come from Profile of Saskatchewan, Census of Canada (2001)

[b] The average level of educational attainment in Saskatchewan is calculated from Profile of Saskatchewan, Census of Canada (2001) this is a high school diploma plus some post secondary.

[c] The average household income in Saskatchewan comes from Profile of Saskatchewan, Census of Canada (2001).

[d] Median income is listed by the category used to collect this information in the survey instrument.

[e] Not available.

### 3.4 Case Study

The following section is the case study examining provincial group (PG) and local group (LG) result in terms of attitudes, opinions, feelings and preferences towards forest management in Saskatchewan. The provincial group results were estimated using only data collected with survey version $L_7$. For this case study the use of the single data set was deemed appropriate, because the survey employed to collect this data used the exact design of the survey used by Shapansky et al. (2001) to collect the LG sample. Thus, we could be assured that design issues were not clouding the PG results.

#### 3.4.1 Comparison of Local and Provincial Samples

When comparing the demographics of the local group collected by Shapansky et al. (2001) versus the provincial group it is clear that the groups differ substantially in many of the categories. The groups are similar in terms of age (48.8 local and 43.8 provincial) and education (both groups have the mean average of education equivalent to a community college or technical school diploma). The local group had a higher mean income of 70 000 as compared to the mean income of 58 700 for the provincial group. In terms of gender, the provincial group has more women (58%) and the local group has more men (79%). In terms of memberships in organization the local group participates in many more environmental/conservation groups and hunting and fishing organizations than the provincial group. The two groups are similar regarding natural history organizations. The local group and provincial group are similar concerning the percentages that are dependent on natural resources with 32% in the local group and 23.3% in the provincial group.

**Table 3.5: Demographics for Provincial versus Local public involvement groups**

| Demographic Variable | Provincial Group | Local Group |
|---|---|---|
| **Number in Group** | 60 | 19 |
| **Mean and Median (Std Dev) Age (years)** | 43.8,43(15.3) | 48.8, 51(11) |
| **Number of Women** | 35 (58%) | 4 (21%) |
| **Median Education (Std Dev)** | 5 (1.6) | 5 (1.83) |
| **Mean Household Income $ (Std Dev)** | 60 000 (24 100) | 70 000(32 000) |
| **Environmental or Conservation Grp Membership.** | 1 (1.6%) | 8 (42%) |
| **Natural History, Birdwatching ect. Organizations** | 10 (16%) | 2 (11%) |
| **Hunting/Fishing Organizations** | 4 (6.7%) | 11 (58%) |
| **Number dependent on Oil & Gas Forestry, Mining Ect.** | 14 (23.3%) | 6 (32%) |

### 3.4.2 Attitudes, Beliefs and Feelings

The following section compares the Provincial Group and the Local Group in terms of their beliefs regarding threats to forests, their mind set and their opinions about forestry.

There were few significant differences existed between the Local Group (LG) and the Provincial Group (PG) regarding their perceived threat to forests in Saskatchewan. Both groups found the amount of trees being logged to be the greatest threat although the provincial group perceived forest fires as an equally dominating hazard. Other chief threats for the two groups are logging practices, climate change, and loss of land. The practices considered to be of least concerns for both groups are the amounts of recreation in the forests, oil and gas exploration and negative publicity surrounding forest management. Recreation was the one threat in which the two groups differed regarding forest threats. The provincial group felt that recreation was more of a threat then the local group.

**Table 3.6: Perceived threats to forests in northwestern Saskatchewan: *t*-tests for differences in means between groups [a]**

| Statement | Provincial Group | Local Group | tstat |
|---|---|---|---|
| Forest Fires | 3.2(0.12) | 2.88(0.97) | 1.43 |
| The amount of trees being logged | 3.2(0.12) | 3.4(0.71) | -1.22 |
| Climate Change or global warming | 2.98(0.12) | 3.04(0.98) | -0.27 |
| Loss of forested land for other purposes such as agriculture or urbanization | 2.87(0.12) | 3.12(0.88) | -1.23 |
| Logging Practices | 3.09(0.1) | 3.12(0.78) | -0.17 |
| Insects and disease | 2.7(0.1) | 2.62(0.58) | 0.6 |
| The amount of forested land in the province allocated for timber harvesting | 2.79(0.12) | 2.92(0.67) | -0.84 |
| The amount of recreation use occurring in the forest | 2.29(0.1) | 2.04(0.61) | **1.78*** |
| Oil and gas exploration and pipelines | 2.54(0.11) | 2.6(0.91) | -0.29 |
| Negative publicity about forest management | 2.62(0.12) | 2.92(0.91) | -1.43 |

* indicates significant at the 95% confidence level

[a] A Likert scale was used which ranged from 1 (not a threat at all) to 4 (great threat). 5 (no opinion) was removed from the data set.

When asked about how they feel towards forests both the LG and PG groups revealed that they strongly agreed with the statements expressing feelings that forests exist for reasons other than their physical and recreational usefulness. This indicates that both groups recognize that forests have a value beyond what can be measured by a traditional market. Both groups on average agreed most strongly with the statement signifying a feeling that it is important that they know forests exist in Saskatchewan regardless of whether they are able to enjoy them directly. Both groups were found to be in disagreement with statements that touted views that forests are wasted when not used to serve humans. The only threat the two groups differed significantly on was the amount of recreation occurring in the forest. Recreation was perceived to be a greater threat to forests for the provincial group than for the local group.

The LG and PG differed significantly on two statements regarding their feelings towards forests. The LG reported that they felt stronger agreement regarding the statement that forests should be managed to meet as many human needs as possible. The

PG indicated that they felt a significantly stronger agreement with the idea that forests should be less managed by humans and left to natural disturbances. These differences are interesting but not surprising. They suggest that the two groups differ on their views of forest management with the LG feeling that management is more important. The LG lives within the northwestern forest and is therefore more affected by the management of forests. They are more intimate with the ways in which forests are important to satisfying needs and the dangers that may arise for themselves and their property should managers fail to intervene in some natural occurrences such as fire.

**Table 3.7: Participants feelings towards forests: *t*-tests for differences in means between groups**

| Statement | Provincial Group | Local Group | tstat |
|---|---|---|---|
| Whether or not I get to visit the forest as much as I like, it is important for me to know that forests exist in NW Sask. | 4.79(0.09) | 5(0.4) | -1.44 |
| Forests should be managed to meet as many human needs as possible | 3.25(0.2) | 4(1.3) | **-2.85*** |
| Forests should have the right to exist for their own sake, regardless of human concerns and uses | 4.18(0.14) | 3.8(1.3) | 1.44 |
| Forests are sacred places that give us a sense of peace and well-being | 3.8(0.16) | 4(1.3) | -0.76 |
| Forests should exist mainly to serve human needs, if not it is a waste of natural resources | 1.64(0.15) | 1.6(1.1) | 0.16 |
| It is important to maintain the forests for future generations | 4.73(0.13) | 4.92(0.3) | -1.49 |
| Forests should be left to grow develop, and succumb to natural forces without being managed by humans | 2.93(0.17) | 1.92(0.8) | **4.89*** |
| Humans should have more respect and admiration for the forests | 4.66(0.1) | 4.63(0.6) | 0.17 |
| Forests let us feel close to nature and rejuvenate the human spirit | 4.63(0.09) | 4.68(0.5) | -0.31 |
| If forests are not threatened by human actions, we should use them to add to the quality of human life | 4.35(0.11) | 4.6(0.9) | -1.15 |
| Forests can be improved through management by humans | 3.98(0.14) | 4.25(0.9) | -1.24 |
| Wildlife, plants and humans should have equal rights to live and develop | 3.71(0.17) | 4.1(1.3) | -1.49 |
| The primary function of forests should be for the products and services that are useful to humans | 2.11(0.16) | 1.8(0.9) | 1.42 |

***** indicates significant at the 95% confidence level

[a] A Likert scale was used which ranged from 1 (Totally Disagree) to 5 (Totally Agree). 6 (not sure) was removed from the data set.

The opinions (Table 3.8) of respondents in the LG and PG groups were again quite similar. The two groups specified that community involvement in forest management is important. However the answers of both groups revealed that at the provincial and local level respondents did not agree that citizens have enough input into management. The PG and LG groups indicated that they felt forests are being managed to meet a wide range of uses aside from timber and that environmental concerns are taken into account.

The PG and LG groups diverged significantly regarding their opinions on the ability of forests to meet future needs. The provincial group holds a more optimistic opinion. This may be explained by the higher percentages of LG group members involved in environmental and outdoor organizations. The issue of the impact of forest management on rural communities also caused a significant divergence among the LG and PG groups. It is apparent that the LG group feels more strongly that forest management should minimize impacts on hunting and fishing, create more recreation, plant and animal products and jobs. However, the LG feel significantly stronger than the PG that the forest industry has too much control over the forests. It is not surprising that the provincial group feels less strongly towards management issues and involvement as they are on average more removed from rural life in the northwestern forest.

**Table 3.8: Respondent opinions on forest management in Saskatchewan: t-tests for differences in means between groups**

| Statement | Provincial Group | Local Group | tstat |
|---|---|---|---|
| Forests are being managed for a wide range of uses and values not just timber | 3.97(0.12) | 3.84(1.28) | 0.44 |
| Forest management does a good job at including environmental concerns | 3.56(0.14) | 3.04(1.33) | 1.70 |
| There will be sufficient wood in SK to meet our future needs | 3.1(0.21) | 2.32(1.14) | **2.95*** |
| SK has enough protected areas such as provincial and national parks or wilderness areas | 2.42(0.19) | 2.17(1.38) | 0.79 |
| When making forest decisions the concerns of communities close to the forest should be given higher priority that other distant communities | 3.7(0.14) | 4.04(1.12) | -1.32 |
| Forest management should try to create more jobs though commercial recreation, tourism harvesting plant and animal products, mining ect. | 3.2(0.17) | 3.88(1.27) | **-2.32*** |
| The present rate of logging is too great to sustain our forests in the future | 3.77(0.17) | 3.9(1.28) | -0.44 |
| Forests are being managed successfully for the benefit of future generations | 2.97(0.2) | 2.65(1.4) | 0.99 |
| The forest industry controls too much of SK forests | 3.5(0.18) | 4.17(1.03) | **-2.81*** |
| Communities that depend on the forest for their economic well-being are given adequate consideration in forest management | 2.9(0.19) | 2.87(1.250) | 0.10 |
| Enough harvested trees are being replaced by planting new ones or by natural seeding to meet our future needs | 2.88(0.23) | 2.28(1.46) | **1.78*** |
| The economic benefits from the forestry usually outweigh any negative consequences | 2.2(0.14) | 2.33(1.52) | -0.37 |
| Economic stability of communities is more important than setting aside forests from logging | 2.26(0.16) | 2.44(1.36) | -0.58 |
| Forestry practices generally produce few long-term negative effects on the environment | 2.4(0.16) | 2.54(1.47) | -0.41 |
| The citizens of SK have enough say in forest management | 2.02(0.16) | 2.04(1.04) | -0.08 |
| Forest management should try to minimize impacts on traditional rural ways of life (hunting and fishing food) | 4.1(0.14) | 4.64(0.96) | **-2.44*** |

***indicates significant at the 95% confidence level**

[a] A Likert scale was used which ranged from 1 (Totally Disagree) to 5 (Totally Agree). 6 (not sure) was removed from the data set.

### 3.4.3 Results of Linear Conditional Logit Models

The following results are the product of the Choice Experiments that were a part of both the survey conducted by Shapansky et al. (2001) and the author of the present study.

**Table 3.9: Parameter Estimates for conditional logit models for the Provincial Group and Local Group choice experiments**[13]

| Variable and Description | Provincial Group | Local Group |
|---|---|---|
| **Base** (Intercept) | 1.46 (9.332)* | 0.770 (3.061)* |
| **Moose** (Ungulates) | 0.0272 (2.140)* | 0.1181 (5.384)* |
| **Caribou** (Special Species) | 0.6358 (6.687)* | 0.607 (3.533)* |
| **Forest Age** (% Old) | 0.08594 (5.49)* | 0.05715 (2.144)* |
| **Recreation & Access** | | |
| **Recreation 1** (2 WD) | -0.3103 (-3.021)* | -0.063715 (-0.391) |
| **Recreation 2** (4WD) | 0.1655 (1.75) | -0.15347 (-0.907) |
| **Recreation 3** (ATV required) | 0.2435 (2.509)* | 0.34236 (2.106)* |
| **Recreation 4** [a] **(calc.)** (Foot Access) | -0.0987 | -0.1252 |
| **Protected Areas** (Above Current Amount) | 0.1811 (3.331)* | 0.19514 (2.086)** |
| **Employment** (Direct and Indirect Forestry Jobs) | 0.1747 (3.41)* | 0.2122 (1.925)** |
| **Tax** | -0.4173 (-4.381)* | -0.2705 (-1.385)* |
| **Log-Likelihood** | -886.82 | -203.074 |
| **Rho Squared** | 0.0827 | 0.113 |

*significant results for 95% confidence level

**significant results 90% confidence level

[a] effects coded variable.

Table 3.9 describes the parameter estimates for the conditional logit models estimated for both LG and PG. The parameter estimates can be interpreted as explaining the relationship between the attribute $X_j$ and the probability that choice $y_i$ is chosen. A positive sign on the parameter indicates that there is an increasing probability that the choice with a greater amount of that attribute will be chosen. This indicates that an individual will receive increased utility by picking the choice which contains a higher amount of that attribute. A similar interpretation follows for a negative sign on a parameter estimate. This indicates that an increase in attribute $X_j$ will decrease the probability of picking choice $y_j$.

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[13] Tests of both models show that the null hypothesis that the coefficients are not significantly different from zero is rejected.

The moose, caribou, and forest age parameters are positive and significant for both LG and PG at the 5% level. The protected areas and employment variables are significant at the 10% level for the LG group and the 5% level for the PG group. The tax parameter is negative and significant for both groups, signifying that respondents would be less likely to choose alternatives with higher tax levels. This same interpretation can be applied to the two-wheel drive recreation parameter (recreation 1) for the PG group. However, for both groups the all terrain recreational vehicle (recreation 3) parameter is positive and significant revealing that both groups would experience an increase in utility when selecting options with this variable. The other recreation parameters were not significant.

### 3.4.5 Welfare Measures: Trade-offs

In order to measure the economic value of a change in a passive use value case, welfare measures are calculated. Compensating variation, defined as how much will have to be paid to a respondent in order to make them as well off as they were before the change, was calculated. In this case study the value of a 5% increase above the status quo level for five attributes is estimated. The values estimated determine how much an individual would be willing to pay for a 5% increase in the variable while maintaining the same utility. A general expression of compensating variation (CV) can be written as:

$$V^1 = V^1 (P^1, M^1, Q^1) = (P^1, M^1\text{-}CV, Q^2) = V^2$$

Where $V^1$ is the initial utility based on income (M), price (P) and quality (Q). A change from $Q^1$ to $Q^2$ is representative of an improvement in quality.

The order of the attributes in terms of economic value for the two groups is similar (Table 3.10). In both groups the marginal welfare impact of a 5% increase in an attribute is greatest for Forest Age followed by protected areas and jobs. However, in the PG group the value of a 5% increase in caribou is greater than for moose.

Comparisons of the welfare measures for each specific attribute disclose unsurprising figures. The welfare change from altering the moose numbers is higher in the LG group than the PG group which may point to a preference for hunting that would be expected in a more rural forested area. The attributes of Forest Age and Jobs are as anticipated in a region dependent on the forest industry. The PG group has a higher value for an increase in Forest Age indicating that they would like to see more old growth forest as opposed to the LG group. The LG group may have a higher overall preference for seeing trees used to support industry in the area. In terms of jobs the LG group indicates that a change in jobs would have a higher welfare impact on them then the PG group. This is an expected result considering that the jobs would have the greatest impact in the community.

**Table 3.10: Estimates of the economic welfare associated with a 5% increase in each attribute holding the levels of the other attribute constant for the Provincial and Local Group**

| Attribute (5% increase from Current Situation) | Provincial Group | Local Group |
|---|---|---|
| **Moose** | $2.44 | $13.72 |
| **Caribou** | $3.05 | $3.10 |
| **Forest Age** | $103.00 | $72.88 |
| **Protected Area** | $43.3 | $49.77 |
| **Jobs** | $12.56 | $17.60 |

### 3.5 Conclusion

Shapansky et al.'s (2002) work allowed insight into the attitudes and preferences of the local population. The data collected for this thesis extends the previous research to a provincial sample, allowing for an opportunity to compare the attitudes and preferences of the two groups. In this chapter we find that the local group and provincial group are similar in terms of demographics and thoughts towards possible forest threats. We find that the local and provincial groups differ as expected in some opinions and welfare measures concerning industry impacts on jobs and rural ways of life.

The work of Shapansky et al. (2002) offered a starting point for the present research by providing the basic survey design. Shapansky et al.'s (2002) results indicated that the choice experiment design was effective in supplying researchers with results that reflect respondent preferences towards attributes of forest management. However, the findings reveal a partiality for the status quo situation. This is evident from the positive and significant base intercept in Table 3.9.[14] Known as a Status Quo Bias, it is a concern for researchers as it may indicate that respondents are overburdened when completing choice tasks. Thus the following two chapters of this thesis examine complexity in choice experiments.

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[14] The base intercept is the alternative specific constant. It was defined as the status quo (current situation) for this analysis.

# 4.0 Complexity in Choice Experiments: Exploring Status Quo Bias

## 4.1 Introduction

A continuing dilemma encountered by researchers in using preference elicitation techniques is the trade-off they must face between thorough, accurate descriptions and the ability of respondents to understand and process the questions in order to provide meaningful responses. For economists employing choice experiments the issue is just beginning to become an important focus. The attraction of CE is the advantage that it holds over more traditional methods such as CVM. The CE forces respondents into situations in which they must make trade-offs among the attributes of alternatives. This has the potential to yield greater information than CVM approaches concerning consumer preferences. However, it comes at the cost of requiring considerable mental effort by respondents (Swait and Adamowicz, 2001a). Little research has been done to define the boundaries of complexity leaving researchers concerned about bias in CE results, especially in terms of welfare measures (DeShazo and Fermo, 2002; Mazzotta and Opaluch, 1995).

Status quo bias is a well known and documented phenomenon in the economics literature (Samuelson and Zeckhauser, 1988; Hartman et al., 1990). Adamowicz et al. (1998) and Salked et al. (2001) completed studies that indicate the effect is present in choice experiments. The purpose of this study is not to determine which aspect of status quo bias is at play in the results, but to gain some insight into whether complexity encourages status quo selection as a heuristic strategy. Increases in complexity may generate a desire to retain what is known in the face of uncertainty (an endowment effect) or to avoid the decision entirely by deciding not to choose (omission bias).

The number of single and multiple attribute differences between alternatives and the number of choice tasks in the CE characterize complexity in this study. It is hypothesized that as the number of single and multiple attribute differences among alternatives in a choice set increase, respondents will be more likely to choose the status quo alternative. A second hypothesis is that as the number of choice tasks increase there will be an increasing probability that respondents will choose the status quo. Individual characteristics such as age and education levels are hypothesized as affecting the degree of status quo bias. Heterogeneity in the status quo bias may be in part explained by the individual characteristics of respondents.

The structure of this chapter is as follows: A literature review and background section will provide insight into the rationale for the selection of the hypotheses and an overview of the issues surrounding status quo bias. This section is followed by a description of the empirical model and a discussion of the results.

## 4.2 Literature Review: Status Quo Bias

Samuelson and Zeckhauser (1988) observed that status quo bias may be comprised of respondents desire to remain with the current situation or to opt out of the choice. However, choice of the status quo may also be a response to increasing complexity and this status quo choice is a heuristic used by the respondent. A goal in this present study is to statistically examine factors influencing the degree of status quo bias.

### 4.2.1 Endowment Effect

Over the last two decades the endowment effect has been revealed in the economics literature as an interesting irregularity. Morrison (2000) demonstrated that the shape of indifference curves may not actually conform to that expected by theory. Indifference curves may be kinked at the point of endowment. Prior to an endowment two commodity bundles will appear to be of equal value to an individual. Upon receiving an entitlement of a particular good the utility curve pivots thereby increasing the level of utility associated with the endowment.

Research involving CVM revealed an endowment effect. Notable studies were those conducted by Hartman et al. (1990; 1991). Their studies involved customers of a gas and electric company in the United States. Customers were asked to provide both a WTP and a WTA for service reliability (power outages) and rates. They were also presented with a menu of six service options (varying levels of power outages and rates) and asked to state their preferences. Customers fell into two categories; low reliability and high reliability as their status quo state. The results found by Hartman et al. indicated a strong endowment effect. WTA and WTP differed in order of magnitudes of four to one. They also found that when respondents were asked to choose their preferred package, respondents had a strong affinity for their own current situation. In the high reliability group 60.2% choose their original package as the most preferred while only 5.7% opted for the lower reliability groups package despite a reduction in rates of 30%. The same was true of the low reliability groups where 58.3% preferred their original package and only 5.8% wished to switch to the high reliability group package.

Evidence provided in experimental economics seems to support the hypothesis that their initial point of reference affects people's preferences. In summary, there may be utility in maintaining the status quo. This could have serious consequences in all forms of preference elicitation methods due to the nature of the surveys used, which usually comprise of an option reflecting the current state.

### 4.2.2 Avoiding Choice

In analyzing the status quo effect it has been observed that choice of the status quo may in part be a result of an omission bias (Ritov and Baron, 1992; Baron and Ritov, 1994; Schwietzer, 1994) or simply a decision not to choose (Dhar, 1997a, 1997b; Tversky and Shafir, 1992). In CE the status quo alternative acts both as a potential legitimate choice in that the respondent may feel that it is most in line with their preferences or it may act as the default response in which the respondent opts "not to choose". The decision "not to choose" can be further subdivided into a preference for inaction (omission) or a statement of non-participation ("choose none"). The selection of the status quo alternative may be attractive to respondents as it allows the respondent to avoid making difficult trade-offs that may be intimidating on either a cognitive or emotional level.

#### *4.2.2.1 Omission Bias*

A review of omission bias is important in this paper because within a CE omission bias will always be confounded with the status quo in certain kinds of designs. In order to remain with the status quo an action is not required of a respondent; only an omission whereas if a respondent wishes to choose a new option an action is required (Baron and Ritov, 1992). If respondents do not wish to act, they simply mark the box under the current state of the world option. However, if respondents wish to move away from this current state (i.e. the status quo) they must act out their choice by evaluating the attributes, which comprise the alternate choices provided and select a superior and different alternative. Thus, omission bias can be described as an amplified preference for inaction (Schweitzer, 1994).

Research by Ritov and Baron (1992), Baron and Ritov (1994) and Schweitzer (1994) attempted to distill omission bias from status quo bias in order to determine if the two effects operate on their own or simultaneously. Initial results by Ritov and Baron (1992) revealed that status quo bias is in part a consequence of omission bias. However, later research by Baron and Ritov (1994) and Schweitzer (1994) determined that status quo bias could indeed persist without an underlying omission bias. In choice experiments, as in the real life decisions that they mirror, the inaction response and the current situation are often the same alternative. Schweitzer (1994) found that despite the evidence suggesting status quo and omission bias may be observed independently, responses indicating a higher preference for the status quo were more likely to indicate a preference for an omission response. The correlation among status quo responses and omission responses imply that there may be a common underlying motivation for manifestation of these outcomes.

The preferences for inaction may result from a respondent's reluctance to make trade-offs due to task and emotional difficulty. Ritov and Baron (1992) suggest that this may arise from information processing overload causing an individual to devise methods for coping with the task. By choosing the option that does not require action the respondent is able to forgo making a decision thus avoiding the tedious task of trading off attributes among alternatives (Ritov and Baron, 1992). The desire to avoid actions that may lead to harm or negative effects may also result in a strategy that advocates remaining with the current situation. Baron and Ritov (1994) and Schweitzer (1994) suggest that participants consider actions that lead to bad outcomes to be worse than omissions that lead to bad outcomes. They determined that this may occur regardless of whether the act has resulted in a change from the status quo. However, as the status quo is often confounded with the inaction option, individuals may develop a strategy in which they choose the status quo in order to avoid negative emotions such as regret and responsibility associated with taking an action that results in a poor outcome. Baron and Ritov (1994) refer to this as a "do no harm" heuristic.

#### *4.2.2.2 Opting Out*

Decision making in real life, whether it involves consumer items or personal dilemmas often allows for the opportunity not to decide or to defer the decision. However, the structure of tasks used in many choice experiments does not allow for the decision maker to opt out but instead forces the respondent to make a decision. When a respondent wishes not to participate in the decision making task one likely response may be to remain with the current situation or in effect selecting the "choose none" option.

Research by Tversky and Shafir (1992) and Dhar (1997) revealed that the relationship between alternatives may affect preference for choice refusal. In situations in which there is a high level of conflict among alternatives respondents may be more likely to opt out of decision making. The following simple experiments by Tversky and Shafir (1992) demonstrate these findings. Tversky and Shafir (1992) presented two groups of respondents with a hypothetical situation in which they had come across a sale for CD players. The first group was presented with a very good deal on a Sony CD player. The second group was presented with the same sale on the Sony CD player but this sale included a good deal on another high quality brand of CD player. In the first group only 24% of respondents decided to forgo the sale by delaying the decision whereas in group two the percentage increased to 46%. Tversky and Shafir (1992) attempted to test the results by presenting a new group of respondents with an actual decision in which they were not able to delay the decision. The second experiment simply involved giving respondents a cash payment for filling out a small questionnaire. They then offered the opportunity to trade the cash for a pen of greater value. Approximately 75% of the participants "purchased" the pens. When the experiment was repeated with the addition of another equally valued pen as an alternate to the original, it was found that the number or respondents willing to trade cash for a more valuable pen decreased to 47%. Thus, Tversky and Shafir were able to conclude that the addition of a similar alternative increased the complexity of the decision to the point that respondents will be more likely to forgo a choice or remain with the status quo.

Dhar and Sherman (1996) found that the uniqueness of attributes across alternatives can play a role in the decision to choose the "no choice" option. Houston and Sherman (1995) suggested that when faced with common and unique features of two alternatives respondents will eliminate the common features and make their decision based on the remaining unique features. Dhar and Sherman (1996) determined that when the good attributes of alternatives are shared and the bad features are unique, participants will be more likely to opt out of the decision making task by choosing the "no choice" alternative despite similar overall attractiveness. Respondents may feel less comfortable trading off negative features as they perceive the overall attractiveness of the alternatives as lower (Dhar and Sherman, 1996).

Emotions evoked by the trade-offs required to make a choice have been found to lead to the decision to opt out (Luce, 1998). Luce (1998) found that when trade-offs were required in which highly valued attributes such as occupant survival and accident avoidance were involved respondents preferred to opt out of the decision by choosing the status quo. Luce (1998) finds that equally attractive alternatives can be difficult to choose between if they represent highly valued attributes.

## 4.3 Hypotheses

In this study we define a "single attribute change" as occurring when an attribute level is only different in one of the alternatives. Similarly, a "multiple attribute change" occurs when an attribute level is different across all three alternatives. In value maximization respondents are assumed to be able to reveal their preference for a particular option independently of the context, fatigue or ability. These measures indicate that purely from the design of the choice experiment, complexities were created in the arrangement of attributes among alternatives and the number of choice tasks. This study attempted to determine whether the design of the choice set and characteristics of respondents played a role in increased probability of selection of the status quo option.

The number of single and multiple attribute changes can be considered measures of complexity because as the number of single and multiple attribute changes increase, the greater the alternatives differ. Thus, there are more attributes for consideration by participants. This in turn increases the number of trade-offs that an individual respondent must consider when making a choice. Therefore, a single or multiple attribute change is a representative measure of information load when evaluating alternatives. DeShazo and Fermo (2002) hypothesized that an increase in the number of attributes that differed across alternatives would mentally tax respondents leading to an increase in the variance on the error term in their model. They cite Payne et al. (1988) who offered the opposing hypothesis, that respondents draw upon a reserve of mental effort when challenged by a difficult task leading to a decrease in error variance. However, the DeShazo and Fermo, (2002) results favored their original prediction of increasing error variance. Dellert et al. (1999) tested the consistency of consumer choice when average utility among alternatives was relatively the same but when the number and size of attribute level differences increased. Their results suggest that the cognitive burden associated with an increased number of trade-offs led to less confidence in making a decision that is the "right" choice.

Since this previous research indicates that an increased number of trade-offs can be daunting to survey respondents, the following hypothesis was formulated:

H1: As the number of single or multiple differences in attributes across multiple alternatives increase, the probability of choosing the current situation or status quo alternative will increase.

Accumulating complexity, resulting from large numbers of choice tasks, can cause fatigue among respondents. The repetitive nature of most CEs in which a series of repeated choice tasks with different attribute levels must be considered, can be overwhelming for respondents (Swait and Adamowicz, 2001). Swait and Adamowicz, (2001b) used latent class models to determine if respondents became tired or bored upon completing 16 choice tasks regarding various consumer products such as orange juice. Their results indicated that participants fell into two decision strategy categories as they completed the 16 choice tasks. The first decision category lasted to the eighth choice task upon which respondents rather abruptly switched into the second decision category. The first decision category involved application of a strategy in which the attributes of the products are considered. In the second decision category the strategy was based more on the specific brands of alternatives or the decision to opt out. Swait and Adamowicz

(2001b) concluded that as respondents completed the choice sets they moved from a more involved attribute based strategy to a broader, simpler overall strategy that may include opting out.

Hensher et al. (2001) attempted to determine if respondents exhibit fatigue as they complete choice experiments of varying lengths. They examined choice sets consisting of between four and 32 choice tasks and hypothesized that as respondents move through the tasks they will revert to a method in which one alternative is repeatedly selected. However, the authors found that the tendency to select the same alternative declined as respondents completed the choice sets. They actually found that respondents appeared to be making more trade-offs between alternatives, not less as they completed the choice sets.

The studies by Swait and Adamowicz (2001b) and Hensher et al. (2001) concerned typically purchased consumer items, such as orange juice and airline travel, which may be familiar to respondents. The present study involves choice CEs pertaining to endangered species and forestry. Respondents may be less familiar with these topics and as a result may experience greater difficulty in completing the choice tasks. Given these considerations the following hypothesis was developed:

H2: As the number of completed choice tasks increase, the probability of choosing the current situation or status quo alternative will increase.

The ability of an individual to make a selection in a choice experiment may be exogenous to the design of the experiment. It may be that the willingness of an individual to invest time and mental effort in making a decision is at least partly determined by their personal experience. The experience one has can be represented by some of the attributes of their lives such as their age and education. Individual characteristics may influence the ability of a respondent to apply the appropriate effort to make a decision when faced with a complex choice task (Swait and Adamowicz, 2001b). In the absence of effort, a respondent essentially makes a random decision (Swait and Adamowicz, 2001b).

Several studies examined the effect of age in decision making (Beenstock et al., 1998; Harbaugh et al., 2001; Finucane et al., 2002). In their study on household attitudes toward power outages Beenstock et al. (1998) found that the status quo effect was more pronounced for older respondents. They ascribed this resistance to change, not as a decrease in cognitive abilities, but as the result of life experience. For older consumers experience may have taught them that it is sometimes advantageous to remain with what is known.

Harbaugh et al. (2001) examined the endowment effect in relation to age. These authors found that the endowment effect was equally as strong in all ages examined (groups consisting of average ages of 5 - 20 years). Harbaugh et al. (2001) were interested in determining whether the endowment effect was a mistake that decreased with age and thus indirectly experience, or whether it is a reference dependent preference indicating that status quo bias does not evolve from an individual's characteristics. However, Harbaugh et al.'s (2001) research was focused on generally younger individuals.

Finucane et al. (2002) examined how older and younger adults deal with decision regarding health plans. They found some evidence that increasing age leads to greater comprehension errors and inconsistent preferences. The results of these studies indicate that age may play a role in decision making. However, they do not examine whether age has an effect on the effort required to make decisions when the choice tasks are increasing in complexity. To the best of our knowledge studies do not exist that specifically examine the effects of education on ability to deal with decision making situations.

Based on this previous research the following hypotheses concerning demographic factors were generated:

> H3: Since the age of a respondent may indicate different incentives (in terms of inciting change) to invest effort in the task, it is hypothesized that as the age of a respondent increases they are more likely to choose the status quo option.

> H4: Since the education level of respondents may indicate different levels of ability to choose, it is hypothesized that respondents with higher levels of education are less likely to choose the status quo option.

## 4.4 Model Specification

### 4.4.1 *Experimental Design*

The complexity measures chosen for this study are implicit in the design of the choice experiments examined. The two survey data sets used in this study Woodland Caribou in Alberta (WCAB)[15] and Forest Management in Saskatchewan (FMSK), were designed using orthogonal main effects designs. A large set of choice tasks was produced from these designs based on the number of attributes and levels of the attributes in each study. One sample choice set for each study is shown in Figure 4.1. From the total number of choice sets produced, smaller "blocks" were developed. In both the FMSK and WCAB studies a total of 64 choice sets were produced. However, in the FMSK these were blocked into versions containing 16 choice sets in each survey and in the WCAB survey these were blocked into 8 versions, each containing 8 choice sets. The attributes among alternatives in each study were balanced among the choice sets.

### *4.4.2 Overview of the Data for Woodland Caribou Alberta (WCAB) and Forest Management in Saskatchewan (FMSK)*

Two different discrete choice data sets were used to test the hypotheses proposed in the previous section. The first, the FMSK (discussed in detail in Chapter 3) had 192 usable surveys. This data was collected for this thesis The second, the WCAB examined public preferences for attributes of forest management concerning the endangered/threatened woodland caribou (Adamowicz et al. 1998). For this study a random sample was collected in Edmonton, Alberta, and the final number of usable surveys was 519. This data was collected by Adamowicz et al. 1998.

Table 4.1 lists the characteristics of these two choice experiments. A description of the attribute levels for both choice experiments is provided in Table 4.2 and a sample choice set from each study is displayed in Figure 4.1.

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[15] The WCAB data were obtained from a choice experiment with similar attributes to the attributes of the data obtained for this thesis (FMSK). For a complete description of attributes see Table 2. For a complete description of data see section 4.3.

**Table 4.1: Description of choice task characteristics for Woodland Caribou in Alberta (WCAB) and Forest Management in Saskatchewan (FMSK) models.**

| Choice Set Characteristics | WCAB | FMSK |
|---|---|---|
| Number of alternatives | 3 | 3 |
| Number of attributes | 6 | 5-7[a,b] |
| Number of attribute levels | 4 | 4 (continuous) |
| Number of choice tasks | 8 | 16 |

[a] In each study one of the three alternatives was labeled the "Current Situation"

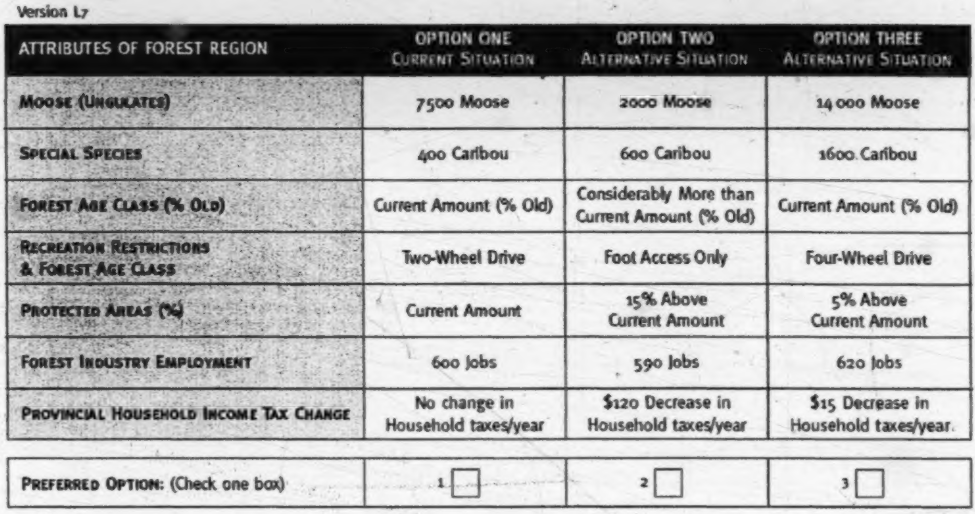
[b] These varied depending upon the survey version (see Table 3.2)

**Table 4.2: Attributes and Levels used in Woodland Caribou in Alberta (WCAB) and Forest Management (FMSK) in Saskatchewan choice experiments.**

| WCAB | Levels of attributes |
|---|---|
| ***Attribute*** | **Levels** |
| *Caribou Population* | 50,400,600, 1600 (animals) |
| *Wilderness Area* | 100 000, 150 000, 220 000, 300 000 (hectares) |
| *Forest Management Agreement Area* | 1 061 000, 1 012 000, 942 000, 862 000 (hectares) |
| *Recreation Restrictions* | 1 no restrictions, 2 activities in designated areas, 3 no hunting fishing off road vehicles, helicopters; horses, camping, hiking 4. similar to three with limited camping and hiking |
| *Forest Industry Employment* | 450, 900, 1 200, 1 250 (direct jobs) |
| *Tax* | $50 decrease, no change, $50 increase, $150 increase (provincial household income tax) |
| FMSK | |
| ***Attribute*** | **Levels** |
| *Moose* | 2,000; 6,000; 7500; 14000 (animals) |
| *Caribou* | 50; 300 to 500; 600; 1,600 (animals) |
| *Forest Age (% old)* | Less then current amount; Current Amount; More than; considerable more than |
| *Recreation Restrictions and Forest Access* | Two wheel drive (2WD) access (1); 4WD access (2); ATV required (3) and Foot Access only (4) |
| *Protected Areas* | Current Amount; 5%; 10% and 15% above Current Amount |
| *Forestry Employment* | Jobs range between 270 and 860 (Current = 600) (direct and indirect jobs) |
| *Tax* | (Current = No Change) Taxes ranged between a decrease of $120 to an increase of $205 year (provincial household income tax) |

## Figure 4.1: Examples of choice tasks used in the Forest Management in Saskatchewan (FMSK) and Wilderness Caribou in Alberta (WCAB) Surveys

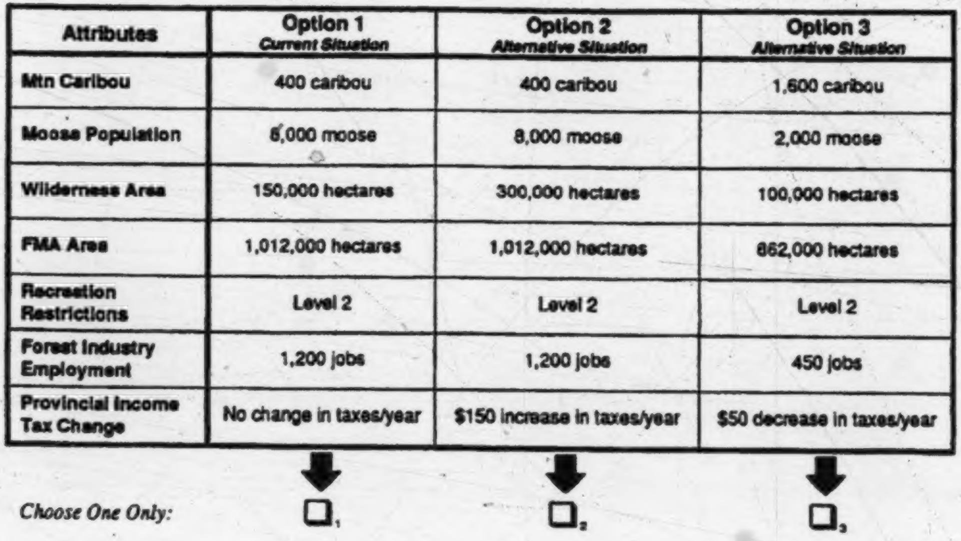
*FMSK Choice Task*[16]



Version L7

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Foot Access Only | Four-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 15% Above Current Amount | 5% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 590 Jobs | 620 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

*WCAB Choice Task*



| **Attributes** | **Option 1**<br>***Current Situation*** | **Option 2**<br>***Alternative Situation*** | **Option 3**<br>***Alternative Situation*** |
|---|---|---|---|
| **Mtn Caribou** | 400 caribou | 400 caribou | 1,600 caribou |
| **Moose Population** | 8,000 moose | 8,000 moose | 2,000 moose |
| **Wilderness Area** | 150,000 hectares | 300,000 hectares | 100,000 hectares |
| **FMA Area** | 1,012,000 hectares | 1,012,000 hectares | 862,000 hectares |
| **Recreation Restrictions** | Level 2 | Level 2 | Level 2 |
| **Forest Industry Employment** | 1,200 jobs | 1,200 jobs | 450 jobs |
| **Provincial Income Tax Change** | No change in taxes/year | $150 increase in taxes/year | $50 decrease in taxes/year |
| ***Choose One Only:*** | ☐1 | ☐2 | ☐3 |

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[16] Versions C and E were also used see Appendix A.

### 4.4.3 *Incorporating Complexity*

*Single and Multiple Attribute Levels*

A measure of complexity was created by examining the numbers of single and multiple differences in attributes across alternatives for each choice set. For each attribute of each task the number of differences in attributes across the alternatives was counted. This was done by creating two new columns beside each line of attribute data; a column for single differences and a column for multiple differences. If for a particular attribute of a particular task, alternatives 1, 2 and 3 were different, then a value of 1 was placed in the column labeled "multiple". If the particular attribute of a task was the same for alternative 1 and alternative 2, but not for alternative 3, then a one was placed in the column labeled "single". For each task of each survey version the number of single and multiple changes for the attributes were summed. Two new variables labeled single and multiple attribute changes were added to the choice model.

*Task Number*

The number of tasks that a respondent was asked to complete was also considered as a measure of complexity. In the FMSK surveys respondents were asked to complete 16 choice tasks while in the WCAB surveys respondents were asked to complete 8 choice tasks.

## 4.5 Estimation and Results

Utility maximizing behavior in a CE is based on Random Utility Theory. Upon evaluating a choice task, decision-makers are assumed to make choices that provide the greatest level of utility. The following equation describes the utility function associated with alternative *j* for a representative individual:

$$U_j = V_j + \varepsilon_j \quad \text{where} \quad V_j = \alpha_{SQ} + \sum_{k=1}^{K} \beta_k X_j^k \qquad \textbf{(4.1)}$$

where $V_i$ is comprised of the sum of the product of a vector of *K* taste weight parameters ($\beta$) and a vector of *K* attribute levels (*X*) for alternative *j*, and a random error term ($\epsilon_j$). $\alpha_{SQ}$ represents the parameter for an alternative specific constant (ASC) for the "current situation" or status quo. In each study this alternative was presented first in the three alternatives offered in each choice set (Figure 4.1). The role of ASCs in a choice model is to improve the fit of the model by accounting for the average effect on utility of exempt attributes (Train 2002). In this case, however, we interpret this parameter as the utility of the status quo alternative. Thus, following Adamowicz et al. (1998) this ASC is plied with a "behavioral assumption of the status quo bias" (see Adamowicz et al., 1998:73).

The first models estimated in this study were the standard conditional logit (CL) models for each data set. However, the CL can be quite restrictive as the coefficients for all parameters entering the model are forced to be the same across all respondents in the data set. Despite this restriction, Hensher and Green (2002) point to the importance of beginning with the estimation of the CL model. The purpose is to ensure that datasets are "clean" and that the parameters are reasonable in terms of expected signs and significance. The estimation of CL models for both data sets in this study revealed that the ASC parameters in each dataset are both positive and significant (Table 4.3). Thus, it is apparent that respondents in both data sets had a propensity to prefer the status quo holding other attributes constant. This suggests that respondents in two separate studies were disproportionately drawn to the current situation over other alternatives and this raises the potential for status quo bias.

The size, sign and significance of the status quo parameter caused us to question whether respondents were actually uniform in their taste for the status quo option. Thus, random parameter logit (RPL) models were estimated for these data. The RPL models were estimated such that the assumption of a constant status quo effect across each respondent was relaxed. This was done by randomizing this ASC over the sampled individuals in each study. Since it is feasible that a respondent could have either a negative or positive preference for the status quo, we specified the status quo ASC as a random normally distributed parameter.

Train (2002) shows that the choice probabilities can be derived from the following formula:

$$L_j = \frac{e^{\alpha_{SQ} + \beta' x_j}}{\sum e^{\alpha_{SQ} + \beta' x_j}} \qquad \textbf{(4.2)}$$

where $L_j$ is defined by Train (2002) as the logit probability evaluated at parameters $\alpha_{SQ}$ and $\beta$. The researcher does not know each individual's tastes for the status quo, therefore the $\alpha_{SQ}$ parameter can be allowed to vary in the population with density defined as $f(\alpha_{SQ} \mid \theta^*)$ where $\theta^*$ are the parameters which represent the mean ($\mu_{SQ}$) and standard deviation ($\sigma_{SQ}$) of the status quo ASC of the respondents in the population. The actual ASCs cannot be observed for each individual so the probability that is given to an individual is the integral of equation 4.2 over all possible values of $\alpha_{SQ}$ weighted by their densities (Train, 1998). Therefore the actual mixed logit probability of choice is:

$$P_j = \int L_j(\alpha_{SQ}) f(\alpha_{SQ} \mid \theta^*) d(\alpha_{SQ}) \qquad \textbf{(4.3)}$$

Following this procedure we estimated a second choice model for each data set where the status quo ASC was estimated as a random parameter and the other taste weight parameters were not random. The third and sixth columns in Table 4.3 report the $\mu_{SQ}$ and $\sigma_{SQ}$ for this random status quo ASC in both data sets.[17] The estimates reveal that the mean and standard deviation of the status quo parameter are positive and significant in both data sets (Table 4.3). Thus the status quo parameters vary over respondents in both data sets, but the distribution falls mostly in the positive region. Based on the imposed normal distribution, the mean and standard deviation parameters suggest that 78% of the respondents in the WCAB data set hold a status quo ASC greater than zero (non-cross hatched area in Figure 4.2a). Similar results emerged in the FMSK population where about 83% of the respondents held a status quo parameter that fell in the positive region of the distribution. Thus, this information suggests that the majority of the respondents in both surveys held significant positive preferences for the current situation.

A further examination of the status quo parameter involved examining elements of systematic heterogeneity associated with choice of the current situation. This involved the complexity measures discussed above (the number of single and multiple attribute level changes and task number effects) and respondent characteristics (age and education levels). To do this the mean of the status quo parameter was decomposed into a number of components as follows:

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[17] To estimate the RPL models the procedures outlined by Train (2001) were used. LIMDEP software was used for this purpose, with 100 Halton draws based on Henser and Green (2002) and Train (2001).

$$\mu_{SQ} = \gamma_1 + \gamma_2 Single + \gamma_3 Multiple + \gamma_4 Task + \gamma_5 Age + \gamma_6 Education \qquad \textbf{(4.4)}$$

The RPL was the re-estimated estimated with heterogeneity in the mean of the random parameter (status quo) as defined below:

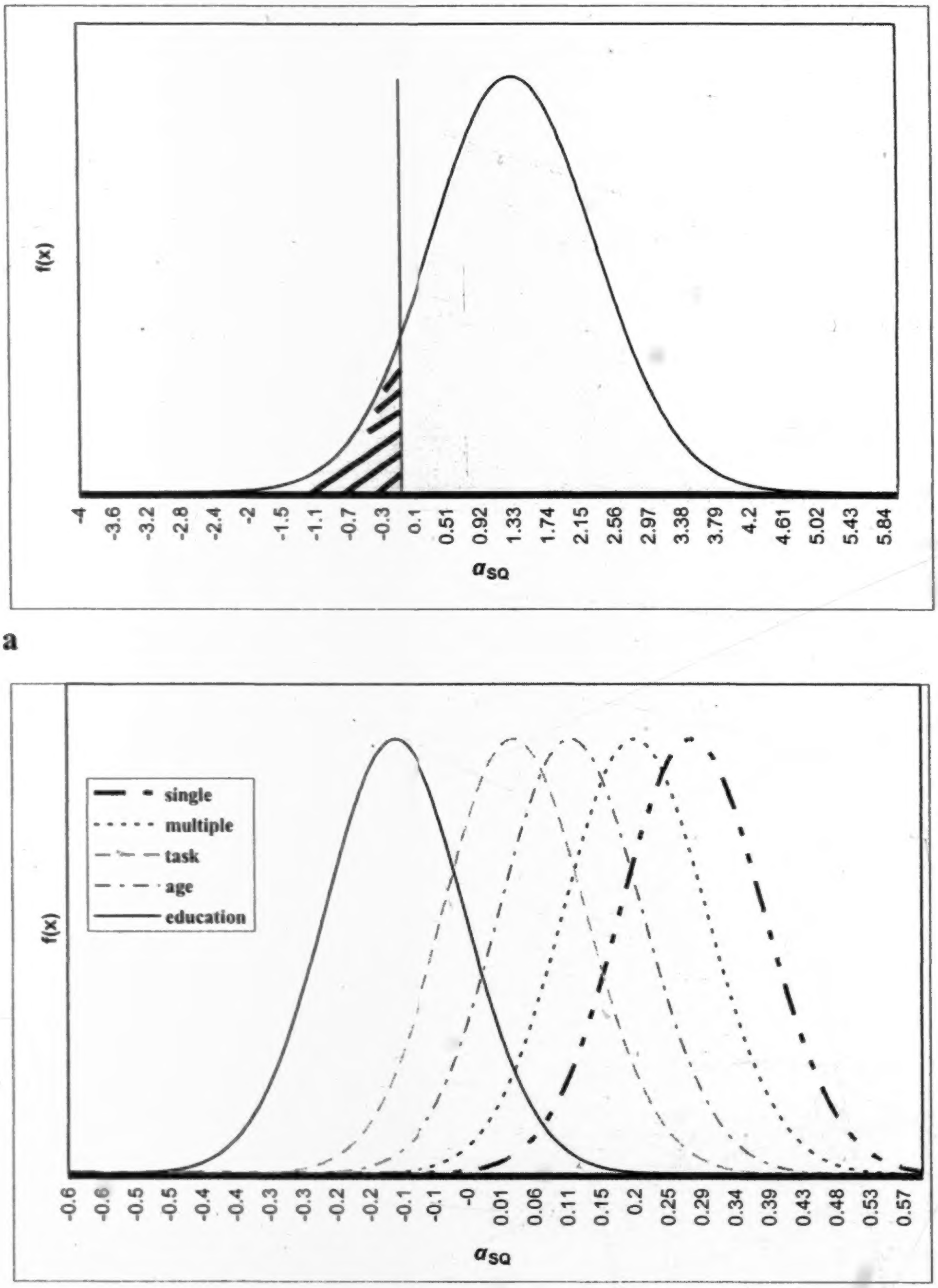
$$\alpha_{SQ} \sim (\bar{\alpha}_{SQ}, \sigma^2 \mid x) \qquad \textbf{(4.5)}$$

Thus, the SQ parameter is assumed to be random given $x$ which represents a vector of; respondent characteristics (age, education) and measures of the complexity of the choice task (single, multiple variables and task sequence). In other words a "shift" occurs in which the mean of the random parameter distribution is allowed to vary according to these variables. This is demonstrated in Figure 4.2.

We found that in the WCAB data set all of the variables describing sub-groups of the sample were significant. In the FMSK education was the only variable that failed to be significant. Thus, in both of the group's age, single and multiple attributes differences and task number play a significant role in explaining preference heterogeneity. This is also true of the education variable in WCAB model.

The attribute parameters in both WCAB and FMSK random parameter logit models are for the most part as expected (Table 4.4). The exception is the insignificant result for forest employment in WCAB. Adamowicz et al. (1998) found the same result when they estimated conditional logit models on this data. They interpreted this as a result of having a urban sample that would be less concerned about forest employment because they are less likely to be dependent on it. The employment parameter is positive and significant for FMSK indicating that higher levels of utility are achieved with increasing employment. Both models reveal positive and significant coefficients for protected areas and caribou suggesting that for both groups utility would be greater with higher levels of those attributes. Forest age is positive and significant for FMSK and

FMA is negative and significant for WCAB. Thus, the results are consistent; FMSK group has a preference for older growth forests while the WCAB does not have a preference for greater FMAs. In terms of recreation, WCAB prefer recreation with fewer restrictions and FMSK prefer recreation with less access by roads suitable for cars and walking but more access by off road vehicles. As expected both groups have a negative and significant parameter on the tax attribute, indicating that for both groups utility decreases with higher taxes.



**a**

**b**

**Figure 4.2 An illustration of the random parameter approach to SQ ASC ($\alpha_{SQ}$) in WCAB. *a* refers to the RPL of column 2 in Table 4.3. *b* refers to the "mean shift" where the mean of SQ can vary according to characteristics of respondents and complexity.**

**Table 4.3: Conditional Logit (CL), Random Parameters Logit (RPL) and Random Parameters Logit (RPL) with Heterogeneity (HET) in the mean alternatives specific constants, random parameters and heterogeneous variables for WCAB and FMSK data sets**

| Status Quo (ASC) | Woodland Caribou in Alberta | | | Forest Management in Saskatchewan | | |
|---|---|---|---|---|---|---|
| | CL (t-stat) | RPL (t-stat) | RPL (HET) (t-stat) | CL (t-stat) | RPL (t-stat) | RPL (HET) (t-stat) |
| $\alpha_{SQ}$ | $1.08^*$<br>(16.6) | | | $1.03^*$<br>(19.1) | | |
| $\mu_{SQ}$ | | $1.32^*$<br>(12.32) | | | $1.17^*$<br>(10.30) | |
| $\gamma_1$:Intercept | | | $-1.01^{**}$<br>(-1.79) | | | -0.42<br>(-0.056) |
| $\gamma_2$:Single | | | $0.28^*$<br>(4.15) | | | $0.18^*$<br>(2.01) |
| $\gamma_3$:Multiple | | | $0.20^*$<br>(2.73) | | | $0.17^{**}$<br>(1.75) |
| $\gamma_4$:Task | | | $0.11^*$<br>(6.22) | | | $0.02^*$<br>(2.07) |
| $\gamma_5$:Age | | | $0.03^*$<br>(4.9) | | | $0.02^*$<br>(1.94) |
| $\gamma_6$ :Education | | | $-0.14^*$<br>(-2.90) | | | -0.04<br>(-0.69) |
| $\sigma_{SQ}$ :standard deviation | | $1.69^*$<br>(18.59) | $1.66^*$<br>(17.38) | | $1.23^{**}$<br>(13.29) | $1.18^*$<br>(13.76) |

$^*$ $P < 0.05$; $^{**}$ $P < 0.10$

**Table 4.4: Complete parameter estimates from the RPL model with heterogeneity in mean for WCAB and FMSK data sets.**

|  | WCAB |  | FMSK |
|---|---|---|---|
| Variable | Coefficient estimate (*t*-stat) |  | Coefficient estimate(*t*-stat) |
| Non Random Parameters in Utility Functions |  |  |  |
|  |  | Moose | 0.056*<br>(9.1) |
| Mountain Caribou | 0.052 *<br>(9.85) | Caribou | 0.078 *<br>(14.2) |
| Wilderness Area | 0.042*<br>(9.35) | Forest Age | 0.091*<br>(12.24) |
| FMA | -0.031*<br>(-2.32) | Protected Area | 0.20*<br>(4.37) |
| Recreation 1 | 0.661*<br>(5.15) | Recreation 1 | -0.311*<br>(-3.41) |
| Recreation 2 | 0.32*<br>(4.1) | Recreation 2 | 0.167*<br>(2.1) |
| Recreation 3 | -0.30 *<br>(-4.58) | Recreation 3 | 0.25*<br>(2.64) |
| Recreation 4 [a] | -0.681 | Recreation 4 [a] | -0.106 |
| Forest Employment | 0.016<br>(1.46) | Forest Employment | 0.027 *<br>(11.07) |
| Tax | -0.0035*<br>(-9.045) | Tax | -0.49*<br>(-9.51) |
| Heterogeneity in Mean, Parameter: Variable |  |  |  |
| Random Parameters in the Utility Functions |  |  |  |
| Status Quo : Intercept | -1.01 *<br>(-1.79) | Status Quo | -0.416<br>(-0.056) |
| Status Quo : Single | 0.28*<br>(4.15) | Status Quo : Single | 0.18*<br>(2.01) |
| Status Quo : Multiple | 0.21*<br>(2.73) | Status Quo : Multiple | 0.17**<br>(1.75) |
| Status Quo : Age | 0.030 *<br>(4.9) | Status Quo : Age | 0.0164**<br>(1.94) |
| Status Quo : Education | -0.14 *<br>(-2.90) | Status Quo : Education | -0.43<br>(-0.69) |
| Status Quo : Task | 0.12 *<br>(6.22) | Status Quo : Task | 0.02*<br>(2.07) |
| Derived Standard Deviation of Parameter Distributions |  |  |  |
| Normal Status Quo s | 1.66 *<br>(17.38) | Normal Status Quo s | 1.18*<br>(13.76) |
| $Rho^2$ | 0.256 | $Rho^2$ | 0.208 |

*P < 0.05; **P < 0.10

[a] Effects coded variable

### 4.6 Discussion

One of the appealing aspects of the RPL is "the ability to re-parameterize the mean estimates of random parameters to establish heterogeneity associated with observable influences" (Hensher and Green, 2002: 5 - 6 ). In this study the alternative specific constant for the SQ becomes a linear function of the attributes of the respondents (age, education and income) and of the variables used to characterize complexity (single and multiple variables).

When the Single and Multiple attribute variables were allowed to enter the mean shift, similar results were revealed for the two data sets. In the WCAB and FMSK models both single and multiple variables were positive and significant. Therefore, the interpretation can be made that as the number of single and multiple differences among attributes across alternatives increases, respondents are more likely to choose the status quo alternative. This indicates that complexity is entering the model as a significant component in both studies examined. The positive significant increase in the number of single and multiple attributes that differ across alternatives supports our earlier hypothesis, which is that respondents may find that the more alternatives differ, the more difficult making a selection becomes. This may be because respondents are forced into a situation in which it is necessary to make more trade-offs, increasing the amount of effort that is required of the respondent. In selecting the SQ respondents may be choosing a "safe" alternative which requires little work and is more attractive.

The effect of complexity on respondents is also revealed when the task variable is included. Again both models demonstrate similar results. The positive coefficient on task is consistent with our previous hypothesis that as fatigue increases people will begin to opt out or hold more strongly to the current situation. As results from Swait and Adamowicz (2001b) reveal, this could be a result of a change in strategy as an individual moves through the series of choice sets in each CE. Respondents may feel less inclined to do the work required of them to evaluate the possible trade-offs based on attributes, and begin switching to a more heuristic based approach by selecting to remain with the current situation.

Respondent characteristics such as age and education were also incorporated as potential explanations for status quo choice. Age was the only variable that produced consistent significant results across both models. The coefficients on age in both data sets are positive indicating that as people age they are more likely to select the status quo. There are two possible explanations for this behavior. It may be that as people age they become more "set in their ways". Beenstock et al. (1999) described this tendency as resulting from being accustomed to situation as a result of being exposed to it for a longer time. A second interpretation may be that as people age they become more experienced. This experience may have taught them that it is more advantageous to remain with what is known. Moving away from the current situation may increase anxiety should negative consequences occur.

In terms of the education variable, however, the two models differ in results. In the WCAB study, increasing levels of education have a significant negative effect on SQ choice, while in the FMSK study the education parameter is not significant. A negative significant sign on the WCAB education coefficient is interpreted as a decreasing likelihood that a respondent will choose the status quo as their level of education increases. This suggests that those who are more educated may have developed enhanced critical thinking skills. Another interpretation may be that participants who have achieved higher levels of education are increasingly able to handle the complexity of a choice experiment, and are less likely to remain with the current situation. The insignificance of education in FMSK study could the result of the small sample size (w = 196).

## 4.7 Conclusions and Future Research

The objective of this study was to determine if particular characteristics of choice complexity and participant characteristics could account for selection of status quo choices. If systematic effects are found, this suggests the existence of status quo bias. This bias is a troubling result in CE studies, as it may be an indicator that respondents do not fully comprehend the choice tasks and are not completing the expected trade-offs necessary to reveal preferences. This may create bias in welfare measures derived from the choice model parameters

A caveat must be applied to this work: the study was completed ex post. The original studies were not designed with the hypothesis of the current study in mind. Therefore, the variables used to account for complexity may be imperfect. However, this leaves room for researchers to design and implement studies that more formally test the effects of complexity on the status quo bias. Potential options would be to conduct the same survey but systematically vary attribute levels differences and number of choice tasks.

This analysis of data generated by WCAB and FMSK studies draw fairly clear conclusions on the influence of complexity on the selection of the status quo. In both groups respondents did appear to be affected by the number of attribute differences between alternatives and by the number of choice tasks. Both studies also found that some individual characteristics played a role in the increased selection of the current situation alternative. In studies dealing with particularly complex and potentially unfamiliar subject matter such as forest management, perhaps the length and structural difficulty must be reduced. The results of this paper suggest that respondents may not be able to handle increasingly higher numbers of trade-offs. Thus, researchers must be cognizant of the number of attributes and attribute level differences included in their choice tasks. For example, fewer attributes or attribute levels might be included. This would require researchers to be cautious to avoid including attributes that are less relevant. In order to insure that only relevant attributes and levels are included more emphasis on the planning stages of CEs a may be required. Perhaps more contact with focus groups and area experts would be valuable.

In terms of the number of tasks, the results indicate that between eight and 16 tasks respondents are more likely to retain the current situation. Thus, it may be necessary to have smaller blocks of choice tasks and larger sample sizes to ensure that the statistical efficiency is retained without compromising the respondent's ability to make decisions due to fatigue.

Apart from reducing levels of complexity within the choice task or over the choice set, other methods exist for dispelling status quo bias. Cummings and Taylor, (1999) present an intriguing method, known as cheap talk, for reducing hypothetical bias in CVM. The idea arose from the game theory literature and involves presenting a script to a respondent which refers to the actual bias and the findings of some researchers concerning the bias. Cummings and Taylor (1999) found some success in reducing the hypothetical bias with this method. The authors acknowledged criticism, which pointed to the method inducing a bias of its own, by suggesting that in cases where hypothetical bias was less significant the cheap talk method had little effect. A possible avenue of research might include attempting to determine if this method has the potential to reduce the status quo bias.

As mentioned in this paper, the status quo effect is comprised of an endowment effect, omission bias and/or an opting out desire. This paper focused on how complexity and individual characteristics may help explain the overall status quo bias. There may be other explanations for the aggravated tendency toward the status quo. For example, the studies presented in this paper may invoke a protest against forest management policies, which may be manifested as a selection of the status quo. It is also possible that respondents frustrated with the choice tasks have used other heuristic strategies. In particular, complexity may aggravate the lexicographic strategy of searching for the highest level of particular attributes.

An important extension of this research might be to devise a method for accounting for the different possible effects in the choice model. In fact, research by von Haefen and Adamowicz (2003) moves in this direction by attempting to account for respondents who are not participating as opposed to those who simply have a preference for the current situation by using single and double hurdle discrete choice models.

This chapter has provided some insight into the some of the potential determinates of the status quo bias. It is important that choice modelers are aware that choice set characteristics and individual abilities may affect respondent decision making. Hopefully, this type of work will encourage researchers to consider these aspects when designing choice experiments.

# 5.0 Effect of Task Structure and Context on Participant Response

## 5.1 Introduction

In this chapter, as in the previous chapter, the focus is on the issue of complexity in choice experiments. In the previous chapter we concentrated on determining whether heterogeneity in respondent ability and choice set complexity could affect selection of the status quo option. In this chapter our interest lies less on the reasons for heuristic response of participants and more on whether changes in specific choice task design elements affect responses. Thus, our hypotheses examine whether systematic changes in choice set characteristics lead to an increase in unexplained variation or "noise" in the choices.

While stated preference methods are commonly used in the marketing and transportation literatures a clear consensus has not been reached in terms of guidelines for the design of a choice set. Perhaps, as suggested by DeShazo and Fermo (2002), this is due to the underlying assumptions of the mystical utility optimizer who is aware of all preferences and able to organize all information. However, much of the research in the human decision branch of psychology has suggested that respondents are effort misers and are prone to difficulties in dealing with large quantities of information. Thus, in order to avoid bias in experimental results, further examination of the extent of respondent ability to deal with varying levels of complexity is warranted. This is possible because the market created is an explicit construct of the researchers. Thus, the choice experiment as a stated preference method lends itself to the manipulation of the design (DeShazo and Fermo, 2002). However, the onus is on the researcher to provide an accurate and complete description of the situation.

It should be noted that although valuable insight can be gained by examining the marketing and transportation literature, these areas are different than research dealing in environmental or health economics. As was noted by Luce (1998), trade-off difficulty may be heightened when dealing with goods not traditionally priced and exchanged in a market. Thus, appropriate choice set characteristics may not be consistent across the various fields of research. When dealing with familiar items such as everyday consumer products or methods of transport, respondents may be quite intimate with preferences. Therefore, greater amounts of information may be more easily handled. In situations in which a respondent does not commonly evaluate the valued good the ability to process information may be less.

In the present study, we systematically varied some characteristics of task complexity in versions of the Forest Management in Saskatchewan survey (FMSK). Respondents' choices are evaluated with regards to various alternative forest management scenarios including the current situation.[18] The tasks we examined differ from many other studies of complexity in that the description of the alternatives involved "unfamiliar" attributes associated with passive use values. These attributes included things like endangered species, old growth forests and protected areas. Many respondents may not be familiar with these attributes. Thus, the alternative management scenarios in the study are complex.

This structure of this chapter is as follows. Section 5.2 provides a review of methods and theoretical background. Section 5.3 gives a description of the hypothesis tested. Section 5.4 is a discussion of the results. Finally, in Section 5.5 we review our conclusions and potential avenues of future research.

## 5.2 Methods and Theoretical Background

Underpinning random utility models is the assumption that an individual will always make a selection which provides them with the greatest level of utility. However, the researcher can observe only aspects of this utility, while the decision maker can only truly know their own utility. Thus, the utility function for choices is composed of the two distinct components described earlier; an observable deterministic element ($V_j$) and a stochastic unobservable element ($\epsilon_j$).

$$U_j = V_j + \epsilon_j \tag{1}$$

It is the error term $\epsilon_j$ that differentiates between the true utility and what Train (2002) refers to as the "representative utility". In this paper we focus attention on the error term because as Train (2002) states: "$\epsilon$ is not defined for a choice situation *per se*. Rather it is defined relative to a researcher's representation of that choice situation" (Train, 2002 p.19).

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[18] The data used in this chapter are explained in chapter 3.

Therefore, systematic changes in complexity can be assumed to enter the estimated choice model through the stochastic component. This chapter focuses on the impact of the number of attributes presented and the labels of alternatives on the variance of the error term. Specifically, we attempt to determine if changes in the number of attributes and labels lead to significantly different error variances between data sets.

The Random Utility Model discussed earlier in Chapter 2 provides a conceptual framework for conducting this analysis. The following equation is a modification of the choice probability functional form presented in Chapter 2:

$$\Pr_j = \frac{\exp\left[\mu(C|\theta)\cdot V_j\left(X_j|\beta\right)\right]}{\sum_{i=1}^{D}\exp\left[\mu(C|\theta))\cdot V_i\left(X_i|\beta\right)\right]} \qquad \textbf{(2)}$$

where $Pr_j$ is the probability that the individual chooses alternative $j$ over all other alternatives which are an elements of choice set $D$ and $\mu(C)\cdot V_j$ represents systematic utilities where $C$ is complexity which is assumed to enter the model through the error term. Thus, $C$ is multiplied by the scale parameter $\mu$ which is the inverse of the error variance $\sigma_j^2 = \pi^2 / 6\mu^2$ (Ben-Akiva and Lerman, 1985). For the statistical derivation of the choice probabilities refer to the work of Swait and Adamowicz (2001a).

When working with a single data set the scale parameter is confounded with the parameter vector and cannot be determined. However, as demonstrated by Swait and Louviere (1993) when multiple data sets are pooled and parameters estimated jointly, a ratio of the scale parameters can be identified. This is demonstrated in the following equation (3) (Louviere, Hensher and Swait, 2000) where $\sigma^2$ is variance $\mu$ is scale and $A$ and $B$ refer to the two data sets used.

$$\frac{\sigma_A^2}{\sigma_B^2} = \frac{\pi^2/6\mu_A^2}{\pi^2/6\mu_B^2} = \frac{\mu_B^2}{\mu_A^2} = \left(\frac{\mu_B}{\mu_A}\right)^2 \qquad \textbf{(3)}$$

Due to the fact that the scale parameter is inversely related to the error variance we are able to determine if the two data sets show differences in their error variances. When complexity differs among choice sets, we may interpret changes in the error variance as being caused by changes in the confidence respondents feel that they can identify the alternative that best represents their preferences. Confusion experienced by respondents may result from a greater difficulty in weighing and evaluating potential trade-offs. Thus, a decline in the consistency in which choices are made in a complex environment will emerge as an affect on the variance of the assumed distribution of the error term.

The study design involved choice sets which had the status quo or current situation choice labeled (L) or unlabeled (U). This is in contrast to the dataset used in the previous chapter where the status quo was always labeled. In addition to the labeled and unlabeled versions, the number of attributes in each choice set version was also varied between seven ($L_7$, $U_7$), seven with two of these attributes held constant ($L_{5+2}$, $U_{5+2}$) and five attributes ($L_5$, $U_5$). The various versions are summarized in Table 5.1.

We adapt the likelihood function laid out in Adamowicz et al. (1997) and Haener et al. (2001) to jointly estimate multiple datasets with scale. For three datasets our likelihood function in the case of the labeled versions was specified as:

$$L(\beta, Z^{L_7} Z^{L_{5+2}} Z^{L_5}, \tau) = \sum_{n=1}^{N^{L_7}} \sum_{i=D_n} f_{in}^{L_7} \ln \Pr\{i \mid \beta, Z^{L_7}\} + \sum_{n=1}^{N^{L_{5+2}}} \sum_{i=D_n} f_{in}^{L_{5+2}} \ln \Pr\{i \mid \beta, Z^{L_{5+2}}\} + \sum_{n=1}^{N^{L_5}} \sum_{i=D_n} f_{in}^{L_5} \ln \Pr\{i \mid \beta, Z^{L_5}\} \tag{4}$$

where $L_7$ and $L_{5+2}$, $L_5$ account for respondents' choices from three data sets, $i$ signifies the alternatives, $f_{in}^{L_7}, f_{in}^{L_{5+2}}, f_{in}^{L_5}$ denote choice frequencies, $\Pr\{i \mid \beta, Z^{L_7}\}$, $\Pr\{i \mid \beta, Z^{L_{5+2}}\}$ and $\Pr\{i \mid \beta, Z^{L_5}\}$ indicate the probability of individual $n$ choosing alternative $i$, $\beta$ is the vector of parameters that is universal between all of the sample versions, $Z^{L_7}, Z^{L_{5+2}}, Z^{L_5}$ represent parameter vectors of those variables that are exclusive to the individual data sets ($L_7$, $L_{5+2}$, $L_5$), and $\tau$ represents the ratio of scale parameters between the different version data samples.

## 5.3 Hypotheses

One of the trigger questions for this research was whether DeShazo and Fermo (2001), in an attempt to guage the effect of attribute numbers on participant response, had made a fundamental mistake by dropping relevant attributes in some survey versions. It was felt that by dropping attributes deemed relevant, a researcher would introduce error into the model, as the model would then be inadequately specified. Thus, in our design we created one version in which we also dropped two attributes ($L_5$ and $U_5$) and one version in which the two attributes that were dropped were instead held constant across attribute levels ($L_{5+2}$ and $U_{5+2}$). Holding the attribute levels constant removes the strain on respondents of having to trade-off attributes while avoiding a reduction in task accuracy by completely dropping attributes. However, by not completely removing the attributes the $L_{5+2}$ and $U_{5+2}$ versions may be perceived by respondents as more complex than $L_5$ and $U_5$ versions because despite two fewer trade-offs there are two extra attributes. This research therefore, extends the results of DeShazo and Fermo's study. As discussed above the error component reflects elements (such as missing attributes) that have not been included in the model. Therefore, by simply dropping two relevant attributes, one would theoretically expect that the error variance would increase.

**Table 5.1: Description of the survey versions**

| Attribute Number | Status Quo Labeled | Status Quo Unlabeled |
|---|---|---|
| 7 attributes All levels allowed to vary | $L_7$ | $U_7$ |
| 7 attributes: protected areas and recreation levels held constant | $L_{5+2}$ | $U_{5+2}$ |
| 5 attributes with levels allowed to vary: protected areas and recreation deleted | $L_5$ | $U_5$ |

The study by DeShazo and Fermo (2001) involved attributes that describe the services and infrastructure (hotel and restaurant quality, toilets and water availability, chance to see wildlife, etc.) of national parks in Costa Rica and Guatamala. They find that, on average, increasing the number of attributes led to an increase in the variance of the error term. Thus, they concluded that larger numbers of attributes in CEs result in a greater cognitive burden and this, in turn, would result in respondents making less consistent decisions. Of course this result is what would be expected when comparing data from two choice experiments when one has a larger number of attributes. However, the important question is whether including attributes that are held constant makes a difference to respondents in terms of complexity or is it a better way of simplifying the task while allowing for a properly specified choice task. Based on this reasoning we developed the following hypothesis:

H1: Systematic changes in the number of attributes will lead to consistent taste parameters across complexity groups but, significant differences in error variances on utility between the three different complexity groups. If complexity is the main factor affecting error variance, we expect that the error variance will be larger for the $L_7$ and $U_7$ when compared to $L_{5+2}$ and $U_{5+2}$ and $L_5$ and $U_5$. However, we expect that the error variance will be greater for $L_{5+2}$ and $U_{5+2}$ when compared $L_5$ and $U_5$.

Thus we test the null hypotheses:

H1L: $\beta_{L7} = \beta_{L5+2} = \beta_{L5}$ and $\mu_{L7} = \mu_{L5+2} = \mu_{L5}$
H1L$_1$: $\beta_{L7} = \beta_{L5+2} = \beta_{L5} = \beta$
H1L$_2$: $\mu_{L7} = \mu_{L5+2} = \mu_{L5} = \mu$
H1U: $\beta_{U7} = \beta_{U5+2} = \beta_5$ and $\mu_{U7} = \mu_{U5+2} = \mu_{U5}$
H1U$_1$: $\beta_{U7} = \beta_{U5+2} = \beta_{U5} = \beta$
H1U$_2$: $\mu_{U7} = \mu_{U5+2} = \mu_{U5} = \mu$

H1L and H1U are the main hypotheses which are each tested using the following two hypothesis; H1L$_1$ and H1L$_2$, H1U$_1$ and H1U$_2$.[19] Where $\beta$ refers to the utility parameters estimated using a particular dataset denoted by the associated subscript, and $\mu$ is the scale parameter labeled in the same way. Although it is not explicit, hypotheses H1L$_1$ and H1U$_1$, are tested with the constraint $\mu_7 = \mu_{5+2} = \mu_5$. Thus, the pooled data set is estimated with joint parameters $\mu\beta$ (Swait and Louvierre, 1993).

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[19] In these Hypotheses L and U refer to Labeled and Unlabeled respectively.

In the previous chapter we focused on the status quo bias. Status quo bias occurs when respondents disproportionately select the current situation when completing choice tasks. As the previous chapter demonstrated, status quo bias was determined to be significant in the Forest Management in Saskatchewan Data Set (FMSK). When designing the choice experiment, it was hypothesized based on previous research in both economics and psychology (Adamowicz et al., 1998; Samuelson and Zeckhauser, 1988; Tversky and Shafir, 1992) that status quo bias would be present. Thus, two forms of the survey were designed. One set of surveys included labeled alternatives which specifically labeled the status quo option as the current situation and, in another set, each alternative was simply listed as "Option one", "Option two" and "Option three". The goal was to determine whether the labels, placed at the top of alternatives in each choice set (see Appendix B, for examples of each version), influenced respondents' choices. It was thought that perhaps labels changed the context of the choice experiment. When the current situation was not labeled respondents may be more likely to make trade-offs among alternatives, since they may be less influenced by the status quo option. As we discussed in the previous chapter the status quo can be a powerful draw as a way to opt out of decision making or in terms of the endowment effect.

Previous research indicates that labels may be an element of the choice experiment context that is influential in respondent decision making. Blamey et al. (2000) question whether choice experiments should present policy alternatives in a labeled or generic format. They find that respondent attention shifts from that of evaluating attributes to a greater focus on policy labels when determining the most preferred alternative. They find evidence of respondents "anchoring" on particular policy labeled alternatives in a labeled format.

When labels are excluded from a choice set it seems that the researcher changes the context of the choice. Following this line of thinking, we hypothesize that:

H2: When the status quo option is not labeled taste parameters will be consistent across complexity groups but, significant differences among error variances ($\mu$) of the labeled and unlabeled groups will be found. We expect that the error variances will be smaller for the unlabelled versions as compared to the labeled versions.

Thus, we test the null hypotheses:

H2(7): $\beta_{L7} = \beta_{U7}$ and $\mu_{L7} = \mu_{U7}$

$H2(7)_1$: $\beta_{L7} = \beta_{U7} = \beta$

$H2(7)_2$: $\mu_{L7} = \mu_{U7} = \mu$

H2(5+2): $\beta_{L5+2} = \beta_{U5+2}$ and $\mu_{5+2} = \mu_{5+2}$

$H2(5+2)_1$: $\beta_{L5+2} = \beta_{U5+2} = \beta$

$H2(5+2)_2$: $\mu_{L5+2} = \mu_{U5+2} = \mu$

H2(5): $H2_9$: $\beta_{L5} = \beta_{U5}$ and $\mu_{L5} = \mu_{U5}$

$H2(5)_1$: $\beta_{L5} = \beta_{U5} = \beta$

$H2(5)_2$: $\mu_{L5} = \mu_{U5} = \mu$

Where again we test the overarching assumption ( i.e.H2(7) ) in two parts (i.e. $H2(7)_1$, $H2(7)_2$).[20]

## 5.4 Results and Discussion

Conditional logit models were estimated with the six individual data sets (Table 5.3), as well as various joint models and joint models with relative scale parameters included (Table 5.4). The value of the log likelihood function at convergence for each estimation is shown in Table 5.2. Using likelihood ratio tests (as suggested by Swait and Louviere, 1993), we tested for parameter equality and scale equality among the various data sets in accordance with the hypotheses outlined above. To illustrate these tests, consider the comparison of the parameter vectors of three models. In the case where two of the data sets are scaled to the third, the test statistic would be computed as:

$$\lambda_a = -2[K_{p\mu} - (K_1 + K_2 + K_3)]$$

where $K_1$, $K_2$ and $K_3$ are the value of the log likelihoods at convergence of the models for the three individual data sets, and $K_{p\mu}$ is the log likelihood of the pooled model estimated with relative scale incorporated for two of the three data sets. This test would be useful in examining whether the parameter vectors of the three models are jointly equal or not.

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[20] In hypotheses H2(7) H2(5+2) H2(5), the number in brackets represents the number of attributes being tested in this set of hypotheses.

Another test that examines the equality of the relative scale parameters among the three data sets would be computed as:

$$\lambda_b = -2[K_p - K_{p\mu}]$$

where $K_p$ is the log likelihood of the unscaled pooled model and $K_{p\mu}$ is the log likelihood of the pooled model as described above. These tests can be generalized as well to cases where two datasets are involved in testing for parameter and scale equality.

To begin, the hypothesis $H1L_1$ regarding the equality of parameters among the three data sets, $L_7$, $L_{5+2}$, $L_5$, was tested. Using the test $\lambda_a$ we were able to strongly reject equality between parameters vectors at the one percent level of significance (Table 5.5). The significant difference in parameters signifies that testing for relative scale difference ($H1L_2$) is no longer necessary. In order to test for relative scale difference it would be necessary to assume that the parameters are equal. This is counter intuitive when the previous test has clearly shown that there is a significant difference between parameters (Swait and Louvier, 1993). However, since we have rejected $H1L_1$, we may also reject our main hypothesis (H1L) and conclude that in this model both parameters and relative scale are not equal.

The second set of hypothesis tests was completed in a similar manner for versions $U_7$, $U_{5+2}$, $U_5$. The first hypothesis tested parameter equality ($H1U_1$). This hypothesis could not be rejected which indicates that among these unlabelled data sets the utility parameter vectors were not significantly different. Next the $\lambda_b$ test was performed to test for scale equality between these unlabelled data sets (hypothesis $H1U_2$ ). We found that we were able to reject this hypothesis, and therefore, H1U can be rejected because, while parameters are not significantly different relative scale is significantly different.

These results suggest that the error variances are significantly different among data sets $U_7$, $U_{5+2}$, $U_5$, but the implied preferences are the same. We conclude that in this unlabelled set of versions ($U_7$, $U_{5+2}$, $U_5$) systematically varying the number of attributes led to more noise in the error term. According to Swait and Louviere (1993) failing to reject $H1U_1$ but $H1U_2$ rejecting indicates that we can interpret the relative scales as a measure of the heterogeneity of the two data sets. If $H1U_1$ had been rejected then a significant relative scale between data sets would be interpreted as "an average multiplier that optimally scales the data of (different) sample(s) 2 to offset the imposition of the $\beta$ parameter equality assumption" (Swait and Louviere 1993 p. 309).

Rejecting hypothesis $H1U_2$ regarding the equality of the scale parameter among data sets $U_7$, $U_{7+2}$, $U_5$ requires further discussion. The estimated relative scale parameters are listed in Table 5.6. The relative scale parameter for group $U_7$ in relation to group $U_{5+2}$ and is 0.80 and for $U_5$ is 1.28.[21] The smaller scale parameter for group $U_7$ relative to $U_{5+2}$ indicates a larger error variance. This is not surprising since $U_7$ had seven attributes as opposed to the seven attributes with two held constant in $U_{5+2}$ and five attributes in $U_5$. If error variances are mainly a function of specification, the larger scale for group $U_5$ is not exactly what should be expected. We hypothesize that two constant attributes should not make a difference in terms of respondent difficulty but, that by dropping relevant attributes the tasks would be less well specified. Thus, we would expect to see a larger error variance for $U_5$. However, these results indicate that respondents tend to view extra attributes as an extra burden despite the fact that in reality the two constant attributes do not require extra work. Therefore, the additional complexity appears to affect variance more than specification affects variance.

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[21] The relative scale for $U_{5+2}$ was not estimated because it is necessary to hold one group constant at $\mu = 1$ during the estimation.

**Table 5.2: Characteristics and values of the log likelihood at convergence of choice models of the various versions.**[a]

| **Model Description** | **Log Likelihood** |
|---|---|
| $L_7$ | -886.82 |
| $L_{5+2}$ | -885.28 |
| $L_5$ | -826.56 |
| $\Sigma(L_7,L_{5+2},L_5)$ | -2598.66 |
| Joint ($L_7$, $L_{5+2}$, $L_5$ $\mu$=1) | -2611.14 |
| Joint ($L_7$, $L_{5+2}$, $L_5$ $\mu_{L7L5}$) | -2610.87 |
| $U_7$ | -925.34 |
| $U_{5+2}$ | -798.09 |
| $U_5$ | -701.58 |
| $\Sigma(U_7,U_{5+2},U_5)$ | -2425.01 |
| Joint ($U_7$, $U_{5+2}$, $U_5$ $\mu$=1) | -2442.26 |
| Joint($U_7$, $U_{5+2}$, $U_5$ $\mu_{U7U5}$) | -2429.96 |
| $\Sigma(L_7,U_7)$ | -1812.16 |
| Joint $L_7$ $U_7$ $\mu$=1 | -1820.32 |
| $L_7$ $U_7$ $\mu$ | -1820.32 |
| $\Sigma(L_{5+2},U_{5+2})$ | -1683.37 |
| Joint $L_{5+2}$ $U_{5+2}$ $\mu$=1 | -1690.06 |
| $L_{5+2}$ $U_{5+2}$ $\mu$ | -1686.01 |
| $\Sigma(L_5,U_5)$ | -1528.14 |
| Joint $L_5$ $U_5$ $\mu$=1 | -1552.11 |
| $L_5$ $U_5$ $\mu$ | -1537.91 |

[a] For a review of the definitions of the data set names please see Chapter 3.

Table 5.3: Linear conditional logit models for versions $L_7$, $U_7$, $L_{5+2}$, $U_{5+2}$, $L_5$, $U_5$

| Variable | $L_7$ (std.er.) | $U_7$ (std.er.) | $L_{5+2}$ (std.er.) | $U_{5+2}$ (std.er.) | $L_5$ (std.er.) | $U_5$ (std.er.) |
|---|---|---|---|---|---|---|
| **Status Quo** | 1.46*<br>(0.1566) | 1.32*<br>(0.1492) | 1.03*<br>(0.0855) | 1.32*<br>(0.0904) | .908*<br>(0.0859) | 1.64*<br>(0.0983) |
| **Moose** | 0.027**<br>(0.0123) | 0.0295**<br>(0.0125) | 0.0428*<br>(0.0128) | 0.0439*<br>(0.0136) | 0.0651*<br>(0.0132) | 0.0649*<br>(0.0145) |
| **Caribou** | 0.636*<br>(0.0951) | 0.635*<br>(0.0933) | 0.716*<br>(0.0947) | 0.842*<br>(0.102) | 0.687*<br>(0.0999) | 0.861*<br>(0.1121) |
| **Forest Age** | 0.086*<br>(0.0156) | 0.0535*<br>(0.0152) | 0.091*<br>(0.0158) | 0.0642*<br>(0.0168) | 0.087*<br>(0.0161) | 0.069*<br>(0.0181) |
| **Recreation 1** | -0.31*<br>(0.1027) | -0.684<br>(0.0982) | NA | NA | NA | NA |
| **Recreation 2** | 0.165**<br>(0.0941) | 0.0453<br>(0.0943) | NA | NA | NA | NA |
| **Recreation 3** | 0.24**<br>(0.0970) | -0.108<br>(0.0989) | NA | NA | NA | NA |
| **Recreation 4 (calc)** | -0.036 | 0.747 | NA | NA | NA | NA |
| **Protected Area** | 0.181*<br>(0.0544) | 0.176*<br>(0.0538) | NA | NA | NA | NA |
| **Forest Employment** | 0.175*<br>(0.0511) | 0.087***<br>(0.0501) | 0.164*<br>(0.0473) | 0.198*<br>(0.0516) | 0.359*<br>(0.0503) | 0.267*<br>(0.0565) |
| **Tax** | -0.417*<br>(0.0952) | -0.459*<br>(0.093) | -0.507*<br>(0.0967) | -0.67*<br>(0.1063) | -0.418*<br>(0.1001) | -0.854*<br>(0.1208) |
| **$Rho^2$** | 0.08 | 0.05 | 0.08 | 0.1 | 0.1 | 0.12 |
| **Log Likelihood** | -886.82 | -925.34 | -885.28 | -798.09 | -826.55 | -701.58 |

* significant for 99% confidence level, **significant for 95% confidence level, ***significant for 90% confidence level

**Table 5.4: Parameter estimates for the joint models and scale models estimated for the various combinations of data sets**

|  | Joint $L_7$, $L_{5+2}$, $L_5$ (std. er) | Joint $U_7$, $U_{5+2}$, $U_5$ (std. er.) | Joint $L_7$ $U_7$ (std. er.) | Joint $L_{5+2}$ $U_{5+2}$ (std. er.) | Joint $L_5$ $U_5$ (std. er.) | $L_7$, $L_{5+2}$, $L_5$ $\mu_{L7L5}$ (std. er.) | $U_7$, $U_{5+2}$, $U_5$ $\mu_{U7U5}$ (std. er.) | $L_7$ $U_7$ $\mu$ (std. er.) | $L_{5+2}$ $U_{5+2}$ $\mu$ (std. er.) | $L_5$ $U_5$ $\mu$ (std. er.) |
|---|---|---|---|---|---|---|---|---|---|---|
|  | 1.0294* | 1.4321* | 1.38* | 1.1768* | 1.2501* | 0.9960* | 1.3364* | 1.3786* | 1.0410* | 1.0217* |
| **Status Quo** | (0.054) | (0.0512) | (0.0977) | (0.0589) | (0.0614) | (0.0505) | (0.0755) | (0.1151) | (0.0704) | (0.0670) |
|  | 0.0446* | 0.0445* | 0.0282* | 0.0434* | 0.0643* | 0.0437* | 0.0452* | 0.0280* | 0.0380* | 0.0495* |
| **Moose** | (0.0074) | (0.0065) | (0.0085) | (0.0098) | (0.0097) | (0.0069) | (0.0075) | (0.0086) | (0.0097) | (0.0087) |
|  | 0.6776* | 0.7564* | 0.6136* | 0.7755* | 0.7562* | 0.6591* | 0.7522* | 0.6274* | 0.6856* | 0.6025* |
| **Caribou** | (0.0555) | (0.0536) | (0.0610) | (0.0667) | (0.0697) | (0.0506) | (0.0688) | (0.0710) | (0.0670) | (0.0636) |
|  | 0.0884* | 0.0603* | 0.0688* | 0.0782* | 0.0790* | 0.0860* | 0.0607* | 0.0685* | 0.0671* | 0.0599* |
| **Forest Age** | (0.0091) | (0.0091) | (0.0109) | (0.0111) | (0.0118) | (0.0091) | 0.0101 | (0.0117) | (0.0104) | (0.0114) |
|  | -0.0866 | -0.0709 | -0.1876* |  |  | -0.0793* | 0.0629 | -0.1873* |  |  |
| **Recreation 1** | (0.701) | (0.0730) | (0.0667) |  |  | (0.0278) | (0.0843) | (0.0691) |  |  |
|  | 0.0977 | 0.0627 | 0.1031*** |  |  | 0.0937* | 0.0165 | 0.1028*** |  |  |
| **Recreation 2** | (0.0895) | (0.0811) | (0.0606) |  |  | (0.0238) | (0.0835) | (0.0615) |  |  |
|  | 0.1600*** | -0.1387** | 0.0658 |  |  | 0.1562* | -0.2003*** | 0.0666 |  |  |
| **Recreation 3** | (0.0935) | (0.0702) | (0.0706) |  |  | (0.0277) | (0.1189) | (0.0655) |  |  |
| **Protected** | 0.1194* | 0.2339* | 0.1772* |  |  | 0.1149* | 0.1970* | 0.1761* |  |  |
| **Area** | (0.0433) | 0.0420) | (0.0345) |  |  | (0.0344) | (0.0517) | (0.0384) |  |  |
| **Forest** | 0.2221* | 0.1802* | 0.1290* | 0.1782* | 0.3182 | 0.2183* | 0.1800* | 0.1285* | 0.1582* | 0.2394* |
| **Employment** | (0.0281) | (0.0272) | (0.0328) | (0.0321) | (0.0349) | 0.0240 | (0.0312) | (0.0344) | (0.0295) | (0.0346) |
|  | -0.4491* | -0.6277* | -0.4379* | -0.5847* | -0.5940 | -0.4361* | -0.6454* | -0.4349* | -0.5207* | -0.5006* |
| **Tax** | (0.0559) | (0.0555) | (0.0604) | (0.0699) | (0.0733) | (0.0490) | (0.0696) | (0.0708) | (0.0661) | (0.0635) |

* significant for 99% confidence level, **significant for 95% confidence level, ***significant for 90% confidence level

**Table 5.4 continued**

| | Joint<br>$L_7$, $L_{5+2}$, $L_5$<br>(std. er) | Joint<br>$U_7$, $U_{5+2}$, $U_5$<br>(std. er.) | Joint<br>$L_7$ $U_7$<br>(std. er.) | Joint<br>$L_{5+2}$ $U_{5+2}$<br>(std. er.) | Joint<br>$L_5$ $U_5$<br>(std. er.) | $L_7$, $L_{5+2}$, $L_5$<br>$\mu_{L7L5}$<br>(std. er.) | $U_7$, $U_{5+2}$,<br>$U_5$ $\mu_{U7U5}$<br>(std. er.) | $L_7$ $U_7$ $\mu$<br>(std. er.) | $L_{5+2}$ $U_{5+2}$ $\mu$<br>(std. er.) | $L_5$ $U_5$ $\mu$<br>(std. er.) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Group $L_7$** | | | | | | 0.0156<br>(0.0684) | | | | |
| **Group $L_5$** | | | | | | 0.0663<br>(0.0452) | | | | |
| **Group $U_7$** | | | | | | | -0.2175**<br>(0.1051) | | | |
| **Group $U_5$** | | | | | | | 0.2452*<br>(0.0720) | | | |
| **Group $U_7$** | | | | | | | | -0.0133<br>(0.7482) | | |
| **Group $U_{5+2}$** | | | | | | | | | 0.2429*<br>(0.0817) | |
| **Group $U_5$** | | | | | | | | | | 0.4276*<br>(0.0785) |
| **Rho$^2$** | 0.09 | 0.09 | 0.06 | 0.09 | 0.12 | 0.08 | 0.09 | 0.06 | 0.09 | 0.12 |
| **LogLikelihood** | -2611.14 | -2442.25 | -1820.32 | -1690.06 | -1552.11 | -2610.87 | -2429.96 | -1820.32 | 1686.01 | -1537.91 |

* significant for 99% confidence level, **significant for 95% confidence level, ***significant for 90% confidence level

### Table 5.5: Likelihood ratio test results for parameter and scale equality between the various data sets

| Hypotheses | Test | Models | $\lambda_a = -2[Kp\mu - (K_1+K_2+K_3)]$ | $\lambda_b = -2[K_p - Kp\mu]$ | df |
|---|---|---|---|---|---|
| H1L: $\beta_{L7} = \beta_{L5+2} = \beta_{L5}$ and $\mu_{L7} = \mu_{L5+2} = \mu_{L5}$ |  | $\sum L_7, L_{5+2}, L_5$ & $L_7, L_{5+2}, L_5\ \mu_{L7L5}$ | 24.42* |  | 10 |
| H1L$_1$: $\beta_{L7} = \beta_{L5+2} = \beta_{L5} = \beta$ | 7 vs 5+2 vs 5 Labeled | Joint $L_7, L_{5+2}, L_5$ & $L_7, L_{5+2}, L_5\ \mu_{L7L5}$ |  |  | 2 |
| H1L$_2$: $\mu_{L7} = \mu_{L5+2} = \mu_{L5} = \mu$ |  |  |  |  |  |
| H1U: $\beta_{U7} = \beta_{U5+2} = \beta_5$ and $\mu_{U7} = \mu_{U5+2} = \mu_{U5}$ |  | $\sum U_7, U_{5+2}, U_5$ & $U_7, U_{5+2}, U_5\ \mu_{U7U5}$ | 9.9 |  | 10 |
| H1U$_1$: $\beta_{U7} = \beta_{U5+2} = \beta_{U5} = \beta$ | 7 vs 5+2 vs 5 Unlabeled | Joint $U_7, U_{5+2}, U_5$ & $U_7, U_{5+2}, U_5\ \mu_{U7U5}$ |  | 24.6* | 2 |
| H1U$_2$: $\mu_{U7} = \mu_{U5+2} = \mu_{U5} = \mu$ |  |  |  |  |  |
| H2(7): $\beta_{L7} = \beta_{U7}$ and $\mu_{L7} = \mu_{U7}$ |  | $\sum L_7\ U_7$ & $L_7\ U_7\ \mu$ | 16.32 |  | 10 |
| H2(7)$_1$: $\beta_{L7} = \beta_{U7} = \beta$ | 7 Labeled vs Unlabeled | Joint $L_7\ U_7$ & $L_7\ U_7\ \mu$ |  | 0 | 1 |
| H2(7)$_2$: $\mu_{L7} = \mu_{U7} = \mu$ |  |  |  |  |  |

* significant results for 99% confidence level** significant results for 95% confidence level

**Table 5.5 continued**

| Hypotheses | Test | Models | $\lambda_a = -2[Kp\mu - (K_1+K_2+K_3)]$ | $\lambda_b = -2[K_p - Kp\mu]$ | df |
|---|---|---|---|---|---|
| H2(5+2): $\beta_{L5+2} = \beta_{U5+2}$ and $\mu_{5+2} = \mu_{5+2}$ | | $\sum L_{5+2}\, U_{5+2}$ & $L_{5+2}\, U_{5+2}\, \mu$ | 5.28 | | 6 |
| H2(5+2)$_1$: $\beta_{L5+2} = \beta_{U5+2} = \beta$ | 5+2 Labeled vs Unlabeled | Joint $L_{5+2}\, U_{5+2}$ & $L_{5+2}\, U_{5+2}\, \mu$ | | 8.1* | 1 |
| H2(5+2)$_2$: $\mu_{L5+2} = \mu_{U5+2} = \mu$ | | | | | |
| H2(5): $\beta_{L5} = \beta_{U5}$ and $\mu_{L5} = \mu_{U5}$ | | $\sum L_5\, U_5$ & $L_5\, U_5\, \mu$ | 19.54* | | 6 |
| H2(5)$_1$: $\beta_{L5} = \beta_{U5} = \beta$ | 5 Labeled vs Unlabeled | Joint $L_5\, U_5$ & $L_5\, U_5\, \mu$ | | | 1 |
| H2(5)$_2$: $\mu_{L5} = \mu_{U5} = \mu$ | | | | | |

* significant results for 99% confidence level ** significant results for 95% confidence level

Table 5.6: Relative scale factor estimates for each design treatment.

| Scaled Logit Model | Estimated Relative Scale Group | Relative Scale Factor | Real Relative Scale ($\beta_i=\beta_j$) |
|---|---|---|---|
| $L_7$, $L_{5+2}$, $L_5$ ($L_{5+2}$)[a] | $L_7$ | 1.02 | |
| | $L_5$ | 1.07 | |
| $U_7$, $U_{5+2}$, $U_5$ ($U_{5+2}$) | $U_7$ | 0.80[*] | Fail to Reject |
| | $U_5$ | 1.28[*] | Fail to Reject |
| $L_7$, $U_7$ ($L_7$) | $U_7$ | 0.99 | |
| $L_{5+2}$, $U_{5+2}$ ($L_{5+2}$) | $U_{5+2}$ | 1.27[*] | Fail to Reject |
| $L_5$, $U_5$ ($L_5$) | $U_5$ | 1.53[*] | |

[a] The group letter in brackets indicates the group that was set equal to 1.0 in the estimation of the relative scale parameters.

[*] Relative scale factors are significant at the 95% confidence level.

It is interesting to note that the only difference between groups is that the choice tasks in groups $L_7$, $L_{5+2}$, $L_5$ were labeled whereas in groups $U_7$, $U_{5+2}$, $U_5$ they were not. Thus, a potential explanation may be that when labels are included those labels influence respondent decisions. These results suggest that when labels are not included in choice tasks respondents base their choices more on the attributes describing the alternatives. This is consistent with the significant sensitivity of respondents to the systematic changes in attributes in groups $U_7$, $U_{5+2}$, $U_5$ as opposed to groups $L_7$, $L_{5+2}$, $L_5$.

We did not find any significant difference concerning the number of attributes in our labeled version. Thus, for the labeled versions ($L_7$, $L_{5+2}$, $L_5$) we cannot comment on whether this supports DeShazo and Fermo (2001) findings. As we discussed earlier in the unlabelled versions ($U_7$, $U_{5+2}$, $U_5$) we did find that error variance declined when two attributes were dropped. This result supports DeShazo and Fermo (2001) and indicates that complexity effects may outweigh missing attribute effects. Therefore, we can conclude that it is up to the individual researcher to determine if it is more important to have respondents who are more at ease with the decision making task or a model which is accurately specified.

The next stage in the analysis involved testing of the differences in parameters and error variances when attribute number is held constant and only label specifications differ. Thus, groups $L_7$ and $U_7$, $L_{5+2}$ and $U_{5+2}$, and $L_5$ and $U_5$ were compared.

For the $L_7$ and $U_7$ comparison we failed to reject $H2(7)_1$ concerning the equality of parameter estimates. Testing the equality of the scale parameter ($H2(7)_2$) revealed that the relative scale parameter for group $L_7$ and $U_7$ was not statistically significant (Table 5.5). Therefore, we may also reject H2(7). For group $L_{5+2}$ and $U_{5+2}$ the likelihood ratio test for parameter equality resulted in the failed rejection of hypothesis $H2(5+2)_1$. Hypothesis $H2(5+2)_2$ was tested to determine if scale parameter equality existed. We were able to reject hypothesis $H2(5+2)_2$ and state that at the one percent level, error variances between groups $L_{5+2}$ and $U_{5+2}$ differ significantly. Again the hypothesis for equality of parameters and scale H2(5+2) was rejected. Among group $L_5$ and $U_5$ the likelihood test for hypothesis $H2(5)_1$ revealed that we were able to reject the notion of equal attribute parameters across the two data sets. Thus, $H2(5)_2$ was not tested and H2(5) was rejected. It is only for group $L_{5+2}$ and $U_{5+2}$ and not for group $L_5$ and $U_5$ that that the significant relative scale difference actually represents a measure of heterogeneity in the error variance.

It is interesting to note that despite the fact that groups $L_7$ and $U_7$ were those with the greatest expected difficulty, the hypothesis tests revealed that there were no significant differences in terms of taste parameters or error variance. It would be expected that as the characteristics of the choice set increase in complexity that respondents would be more sensitive to changes in the context of the task. There are two possible explanations for these results. First, respondents are less dependent on labeling information when the choice task provides them with more information (greater number of attributes). A second potential explanation is that the error variance is actually higher in situations with a larger number of attributes and that this is masking the effect of labeling. It is possible that at higher numbers of attributes the complexity effect is confounded with the labeling effect.

The actual relative scale parameter values for groups $L_{5+2}$ and $U_{5+2}$ (1.27) and $L_5$ and $U_5$ (1.53) indicate that in each case the scale parameter is higher than the fixed scale parameter of 1 (Table 5.6). Thus in the unlabeled version there is less "noise". One interpretation of this result may be that with fewer attributes respondents feel more comfortable making trade-offs based on attributes leading to more consistent choices. In the labeled version it is possible that respondents are more influenced by labels, therefore making less consistent choices.

The status quo parameter is positive and significant for the five treatment types in both labeled and unlabelled versions. This status quo parameter is defined in the model as the alternative specific constant (ASC) as described in Chapter 4. The estimation of relative scale parameters for the five different treatments accounted for the differences in variances across the different data sets in each model. However, the only difference in each of the joint data sets is the treatment (i.e. labeling or varying attributes). Thus, by estimating scale based on a group variable we can assume that the positive and significant status quo ASC indicates that there are other factors affecting the selection of the status quo alternative. Some of these possible explanations include omission bias, decision to opt out and the endowment effect as discussed in Chapter 4.

The larger status quo parameter for group $U_7$, $U_{5+2}$, $U_5$ compared to $L_7$, $L_{5+2}$, $L_5$ is a somewhat puzzling result (Table 5.7). It would be expected that status quo bias would be less pronounced in the unlabelled data set. Two possible explanations exist for this finding. The first is that perhaps respondents simply select the first alternative when faced with a difficult task; in other words a "rule of thumb" such as always selecting the first option in a horizontal sequence of alternatives. The current situation was in the same location for both the unlabelled and labeled groups, thus we cannot examine the use of this potential heuristic.

A second possible explanation is that respondents discovered the status quo by figuring out that the first alternative in each task never changed. The results are as expected for the change in number of attributes. As the number of attributes declines the status quo coefficient is smaller indicating that at lower attribute numbers fewer respondents are drawn to the current situation. In other words, respondents appear to be considering all of the information provided when the task are less complex.

**Table 5.7: Status quo coefficients for the five scaled logit models in Table 5.3**

| Treatment | Scaled Jointly Estimated Logit Models | $\alpha_{SQ}$ |
|---|---|---|
| Labeled | $L_7$, $L_{5+2}$, $L_5$ | $0.99^*$<br>(19.70) |
| Unlabeled | $U_7$, $U_{5+2}$, $U_5$ | $1.33^*$<br>(17.69) |
| 7 attributes | $L_7$, $U_7$ | $1.37^*$<br>(11.97) |
| 5 attributes, 2 held constant (5+2) | $L_{5+2}$, $U_{5+2}$ | $1.04^*$<br>(14.78) |
| 5 attributes | $L_5$, $U_5$ | $1.02^*$<br>(15.25) |

*significant results 95% confidence level

## 5.5 Conclusions and Future Research

The objective of this chapter was to determine if systematic changes to the characteristics and context of a choice task would affect the taste parameters and consistency of choice by decision makers. The results of this study indicate that labels on alternatives probably play a significant role in respondent decision making. It was found that respondents became more sensitive to changing levels of complexity when labels were not included. They were also found to make more consistent choices as the number of attributes decreased. Respondents were also found to make more consistent choices in groups in which the alternatives were not labeled. Thus, we conclude that respondents appear to be making decisions based more on attributes than labels in the unlabeled versions versus the labeled versions. It may be advantageous for choice modelers to consider leaving alternatives unlabelled and to include fewer attributes in their designs. Based on the results of this study such a design decision may encourage respondents to make more trade-offs.

In designing this study, we attempted to determine if there would be some advantage to holding attribute levels constant across some attributes when attempting to reduce the complexity of a choice task for respondents as opposed to simply dropping attributes from the choice task. It is felt that by simply dropping attributes as DeShazo and Fermo, (2001) did, one adds to the model error term by creating a task that is inappropriately explained. Our results revealed that in the unlabeled version complexity effects outweighed specification effects. In other words, the simple existence of two attributes despite being held constant led to less consistent choices in the unlabeled five attributes of varying levels with two held constant group ($U_{5+2}$) as compared to the unlabeled five attributes of varying levels group ($U_5$).

Research concerning the elements of choice experiment design should be of interest to researchers who work with attribute based stated preference methods. The desire is to incorporate as many alternatives and attributes as possible into the choice task design in order to define the systematic component is as completely as possible. However, if there are limits to an individual's ability to process information then substantial bias can be introduced into the resulting econometric models. Respondents begin to abandon efforts of evaluating options by making trade-offs and revert to heuristic strategies. Of course, common sense allows us to recognize that there is some limit to human processing ability. However, these boundaries are vague. Research into these limits should be explored as it is important to continually refine the design of choice experiments. It also must be recognized that these boundaries will vary for different types of research, as respondents may be less familiar with some goods (i.e. environmental goods versus consumer goods).

Future research in this area could involve examining the changes in relative scale parameters between tasks in various survey versions. This may provide valuable insights into whether complexity is compounding as respondents move through the sequence of choice tasks. This would give researchers some direction on the length of choice experiment that can be handled by participants.

# 6.0 Conclusions

The importance of forests for reasons other than direct use became evident upon an informal reading of respondent comments to the survey administered for this thesis. Of those who wished to add comments regarding values they perceived as important, approximately fifteen respondents made some reference to preservation of forests for future generations. Thus on some level members of the public recognize that forests have value that go beyond market value or even value as a presently healthy environment. Therefore, it could be said that public involvement methods that attempt to capture non market values are important. This study examines methods of eliciting such passive use values and assesses the effect of complexity on respondent responses. In particular in Chapter 4 we searched for some explanation of the prevalent status quo bias observed by choice modelers and in Chapter 5 we test changes in choice task design in an effort to reveal respondent limits for structural and contextual complexity of the choice task.

## 6.1 Summary of Results and Design Recommendations

The reluctance of respondents to participate by exclusively selecting or strongly favoring the status quo is a well known phenomenon in the analysis of choice experiment data. This blatantly violates the underlying assumption of compensatory behavior among all decision-makers. This phenomenon is troubling because, the analyst is left without the information required for building accurate utility functions. In Chapter 4 a study was completed which sought to provide some explanation for this bias in the form of changes in complexity and respondent demographics. Two separately collected data sets were used to test hypotheses relating to these issues. The results revealed that in both data sets complexity in terms of the number of attribute trade-offs and tasks were significant. Thus as the number of attribute trade-offs increases and the number of tasks completed increases respondents are more likely to choose the status quo alternative. In terms of demographics significant results were also found as means for explaining heterogeneity in preferences. In both data sets it was found that as age increased a respondent was more likely to select the status quo. Education produced less consistent results as results were only significant in the Woodland Caribou in Alberta data set.

Thus our recommendations are straightforward. Choice modelers must be careful when designing choice experiments to ensure that respondents are not forced into situations in which they are required to make more trade-offs then they can handle. From the results of Chapter 4 we see that it is in the best interest of choice modelers to keep the number of attribute differences to a minimum as increasing attribute level differences leads to increased probability of a status quo response. Thus, insuring that there are more constant attributes across alternatives will alleviate some of the complexity associated with multiple changes in attributes. In terms of number of tasks, researchers must consider countering the use of smaller blocks of tasks with larger sample sizes. Finally, researcher should remain aware of the general demographic characteristics of their respondents as they provide clues on the level of complexity that will be acceptable to include in the choice set design.

The respondent to a survey involving choice experiments possesses a finite ability to deal with information. Thus, it would introduce bias into results by taking the axiom of completeness too literally and assuming that respondents are able to efficiently order preferences when dealing with large attribute sets. Chapter 5 explores systematic changes in complexity both in terms of choice task structure (attributes) and context (labels). The most interesting result that emerged from this study was the responsiveness of respondents to changes in structure under different contextual treatments. It was found that when respondents were exposed to choice tasks that were unlabelled the number of attributes significantly affected them. Respondents were found to make more consistent choices with fewer attributes in unlabeled situations. In the labeled choice sets the number of attributes did not affect respondents.

With the design of choice sets it may be advantageous to provide respondents with fewer attributes. This requires careful consideration on the part of researchers to insure that the most relevant attributes are selected. Perhaps, a greater emphasis on focus groups (both public and professionals) and conversations with experts (policy makers, managers and scientists) will insure that the most relevant attributes are included. In terms of labeling, it may be in the best interest of researchers to reduce the emphasis placed on providing labels. They may distract decision-makers from the important requirement of trading off attributes.

## 6.2 Future Analysis Using Data Collected for the Forest Management in SK Project

Issues other than the complexity of the task can lead to difficulties in decision making. Chapter 4 focused on the effects of structural complexities in the choice task and individual demographics on respondent decision making. However, issues such as respondent confidence and previous knowledge can impact the ability of respondents to make consistent choices.

Selection of an alternative by respondents is assumed made with certainty. Otherwise preferences may be unstable leading to bias or inaccurate welfare measures. In the survey designed for this study the first choice task was followed by a question which asked how respondents felt about their choice in relation to the other alternatives.[22] Respondents were asked to rate their confidence on a five-point scale, which ranged from "only slightly better" to "much better". Thus, we have collected information on the certainty or uncertainty that a respondent feels when evaluating a choice task. This certainty question may provide more explanation in terms of the decision-makers ability to deal with complexity. It would be useful to determine if respondent certainty is related to choice consistency over the changes in number of attributes and labels. However, the weakness of this data set is that it was only collected for the first choice task. It is possible that respondents are the least confident on the first task and gain confidence as they proceed through the choice set.

Previous knowledge of a topic can influence the enthusiasm and ease with which a respondent tackles a choice set. The degree of familiarity with a topic may influence the interest a participant has in completing the choice tasks. If the topic is completely unfamiliar to a participant they may have difficulty relating to choice experiment, as it is likely that the topic is uninteresting to them. Although background information is intended to provide a simple explanation participants may find it more difficult to apply to the attributes if they have not been previously exposed to the topic. However, if the participant has some familiarity with topic, then it is likely that they may have explored the issue on their own in the past and are able to better relate to the attributes of the tasks. In this survey respondents were asked to circle the phrase, which best described their familiarity with forestry in Saskatchewan. Four choices were presented which ranged from “Completely Unfamiliar” (was unaware of forestry in Saskatchewan) to “Completely Familiar” (think or read of it often).

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[22] An example of this question is available in Appendix A: Sample Survey.

Possible future work with this data set could include random parameters logit models that are estimated with certainty and knowledge variables included as coefficients that vary over respondents. These variables may provide valuable insight into the selection of the status quo. Work with these variables was not included in the analysis for this thesis as the work completed for Chapter 4 was based on two data sets. The Alberta Caribou Study did not collect information on certainty and previous knowledge. Therefore the use of these variables was beyond the scope of this thesis.

### 6.3 Broader Potential Avenues of Future Research

This thesis focused on the violation of the axiom of continuity reflected by respondent fixation on the status quo as a preferred alternative. Other respondent heuristics are known to also lead to contravention of the compensatory assumption. In particular lexicographic preferences are a concern. When respondents display lexicographic behavior they are only selecting alternatives with the highest levels of a particular attribute, and they are not making trade-off decisions. A less strict lexicographic preference ordering that has been observed is a form of target setting. This occurs when an individual orders attributes and has required target levels for each attribute to reach before evaluating the next attribute (Scott, 2002). Scott (2002) considered lexicographic preferences in health care choice experiments. He found that complexity provided a potential explanation to an increasing number of respondents with dominant preferences. However, the only measure of complexity provided was choice sets that differed in number of choice tasks (7 tasks and 8 tasks). Thus, future work should examine the effects of complexity on the existence of lexicographic preference ordering. Similar to the work in this thesis, complexity could include structural or contextual variations in the choice task. Scott‘s (2002) work was concerned with health care whereas little work in this area has been concerned with environmental valuation. Although both topics may involve uncertainty among respondents, experiences with health care are different from those with the environment and may relate differently to lexicographic preferences. Therefore, it would be important for a study to explore lexicographic preferences and complexity in environmental valuation.

Survey medium is a topic requiring further study. The majority of choice experiments are conducted using a paper/pencil format. This method is attractive because it has been well tested and researchers are aware of the methods required to achieve meaningful results. However, Internet based choice experiments may allow researchers the opportunity to present information in ways that improve respondent comprehension. For example, it is possible with an Internet survey to provide video clips explaining background information or diagrams that demonstrate attribute changes. A study by Chun and Plass (1996) found that individuals understood reading exercises more fully when visuals were provided. The study focused on language learning, however, the study does indicate that in unfamiliar areas visuals can help with communication.

Internet based surveys may also provide valuable data on choice experiment complexity. Upon changing the levels of complexity across versions as we did in this study it would be valuable to gage the amount of time respondents spent evaluating tasks that vary in complexity. It could be hypothesized that respondents would spend less time on tasks or choice sets they found to be easier. Chapter 4 tested the hypothesis that increasing number of tasks in a choice set increases the difficulty for respondents. One weakness with this measure was that we could not ensure that respondents had completed the tasks in order. Internet surveys could force respondents to follow a particular order by asking individuals to submit each choice task upon completion.

In terms of design of the choice task, a question that requires explanation is the location of the current situation among the other alternatives. Results revealed that in some cases the alternative specific constant (status quo) was higher in data sets that were collected using unlabelled options. It is possible that respondents identify the current situation based on the situation that is not changing. However, the concern is that respondents are simply choosing the first option. In order to answer this question, a study should be designed in which the current situation is moved into the second and third alternative positions. From this research more clues may be provided on the make up of the status quo bias in terms of whether it is a true status quo preference or a protest response.

## 6.4 Final Thoughts on Complexity and Choice Experiments

Before the respondent becomes a decision maker it is the analyst who will have to make some of the most difficult trade-offs regarding ability of respondents to complete choice tasks and the potential for accurate preference descriptions. Theoretically the more information in the form of attributes, attribute levels, labels and number of tasks that is provided to the respondent the greater will be the accuracy of the preferences that are revealed. However, there are limits to the amount of information that respondents can conceivably process. Thus researchers must weigh the importance of including particular attributes and levels versus the need for respondents to develop stable preferences.

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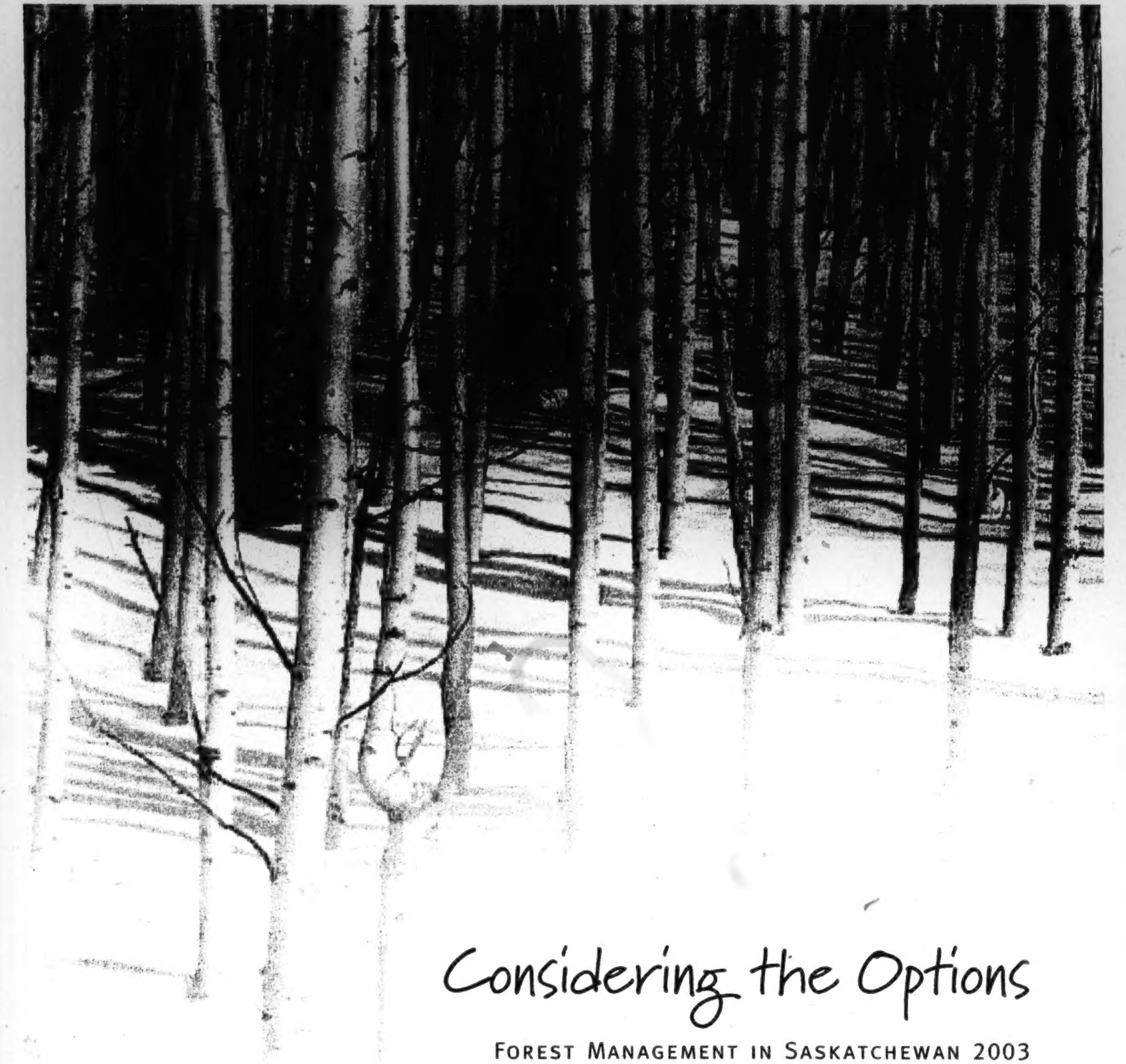

# Considering the Options

## FOREST MANAGEMENT IN SASKATCHEWAN 2003

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# Considering the Options

## FOREST MANAGEMENT IN SASKATCHEWAN 2003

The purpose of this research is to consult the public regarding their land management preferences in the forest of northwestern Saskatchewan (Norsask forest). Both Saskatchewan government and forest industry are interested in attaining sustainability. Public input is a vital component to achieving sustainability by providing information to manage the forest for a wide range of values.

Thank you for taking the time to complete this questionnaire. Please try to answer all of the questions.

ALL INFORMATION YOU PROVIDE IS STRICTLY CONFIDENTIAL. YOUR NAME WILL NEVER APPEAR WITH YOUR ANSWERS. ONLY A SUMMARY OF THE RESULTS WILL BE PUBLICIZED.

Please return you completed questionnaire in the postage paid envelope provided.

We appreciate your help on this project.

Thank you,

Amanda Moon, GRADUATE STUDENT

## PART I - FOREST MANAGEMENT OPINIONS AND BELIEFS

There are no right or wrong answers to these questions in Part I: rather we need your considered response to each question. Please feel free to comment on any question that you feel deserves extra attention. To add your comments use the additional space on the back of the survey or attach your own notes.

Please try to answer all of the questions. If there are any questions you do not wish to answer, you may omit them and move on to the next question.

(1) Listed below are things sometimes seen as threats to our forests. Please rate how much of a long-term threat you think each is by circling the number at the end of the statement that corresponds to the scale. (ie: 1-5 according to the scale)

| | NOT A THREAT AT ALL | NOT MUCH OF A THREAT | SOMEWHAT OF A THREAT | A GREAT THREAT | NO OPINION |
|---|---|---|---|---|---|
| a. Forest fires | 1 | 2 | 3 | 4 | 5 |
| b. The amount of trees being logged | 1 | 2 | 3 | 4 | 5 |
| c. Climate change or global warming | 1 | 2 | 3 | 4 | 5 |
| d. Loss of forested land for other purposes such as agriculture or urbanization | 1 | 2 | 3 | 4 | 5 |
| e. Logging practices | 1 | 2 | 3 | 4 | 5 |
| f. Insects and diseases | 1 | 2 | 3 | 4 | 5 |
| g. The amount of forested land in the province allocated for timber harvesting | 1 | 2 | 3 | 4 | 5 |
| h. The amount of recreation use occurring in the forest | 1 | 2 | 3 | 4 | 5 |
| i. Oil and gas exploration and pipelines | 1 | 2 | 3 | 4 | 5 |
| j. Negative publicity about forest management | 1 | 2 | 3 | 4 | 5 |

(2) One aspect of our study is understanding how people feel about forests. Please indicate how you feel by circling the number that best describes your agreement or disagreement with each statement.

| | TOTALLY DISAGREE | PARTLY DISAGREE | NEITHER AGREE NOR DISAGREE | PARTLY AGREE | TOTALLY AGREE | NOT SURE |
|---|---|---|---|---|---|---|
| a) Whether or not I get to visit the forest as much as I like, it is important for me to know that forests exist in NW Saskatchewan | 1 | 2 | 3 | 4 | 5 | 6 |
| b) Forests should be managed to meet as many human needs as possible | 1 | 2 | 3 | 4 | 5 | 6 |
| c) Forests should have the right to exist for their own sake, regardless of human concerns and uses | 1 | 2 | 3 | 4 | 5 | 6 |
| d Forests are sacred places us a sense of peace and well-being | 1 | 2 | 3 | 4 | 5 | 6 |
| e) Forests should exist mainly to serve human needs, if not it a waste of natural resources | 1 | 2 | 3 | 4 | 5 | 6 |
| f) It is important to maintain the forests for future generations | 1 | 2 | 3 | 4 | 5 | 6 |
| g) Forests should be left to grow, develop, and succumb to natural forces without being managed by humans | 1 | 2 | 3 | 4 | 5 | 6 |
| h) Humans should have more respect and admiration for the forests | 1 | 2 | 3 | 4 | 5 | 6 |
| i) Forests let us feel close to nature and rejuvenate the human spirit | 1 | 2 | 3 | 4 | 5 | 6 |
| j) If forests are not threatened by human actions, we should use them to add to the quality of human life | 1 | 2 | 3 | 4 | 5 | 6 |
| k) Forests can be improved through management by humans | 1 | 2 | 3 | 4 | 5 | 6 |
| l) Wildlife, plants, and humans should have equal rights to live and develop | 1 | 2 | 3 | 4 | 5 | 6 |
| m) The primary function of forests should be for the products and services that are useful to humans | 1 | 2 | 3 | 4 | 5 | 6 |

(3) The following asks your opinion about forest management in Saskatchewan. Please indicate how you feel by circling the number that best describes your agreement or disagreement with each statement.

| | TOTALLY DISAGREE | PARTLY DISAGREE | NEITHER AGREE NOR DISAGREE | PARTLY AGREE | TOTALLY AGREE | NOT SURE |
|---|---|---|---|---|---|---|
| a) Forest are being managed for a wide range of uses and values, not just timber | 1 | 2 | 3 | 4 | 5 | 6 |
| b) Forest management does a good job at including environmental concerns | 1 | 2 | 3 | 4 | 5 | 6 |
| c) There will be sufficient wood in Saskatchewan to meet our future needs | 1 | 2 | 3 | 4 | 5 | 6 |
| d) Saskatchewan has enough protected areas such as provincial and national parks or wilderness areas | 1 | 2 | 3 | 4 | 5 | 6 |
| e) When making forest decisions, the concerns of communities close to the forest should be given higher priority than other distant communities | 1 | 2 | 3 | 4 | 5 | 6 |
| f) Forest management should try to create more jobs through commercial recreation and tourism, harvesting plant and animal products, mining, etc. | 1 | 2 | 3 | 4 | 5 | 6 |
| g) The present rate of logging is too great to sustain our forests in the future | 1 | 2 | 3 | 4 | 5 | 6 |
| h) Forests are being managed successfully for the benefit of future generations | 1 | 2 | 3 | 4 | 5 | 6 |
| i) The forest industry controls too much of Saskatchewan's forests | 1 | 2 | 3 | 4 | 5 | 6 |
| j) Communities that depend on the forest for their economic well-being are given adequate consideration in forest management | 1 | 2 | 3 | 4 | 5 | 6 |
| k) Enough harvested trees are being replaced by planting new ones or by natural seeding to meet our future needs | 1 | 2 | 3 | 4 | 5 | 6 |

| | TOTALLY DISAGREE | PARTLY DISAGREE | NEITHER AGREE NOR DISAGREE | PARTLY AGREE | TOTALLY AGREE | NOT SURE |
|---|---|---|---|---|---|---|
| l) The economic benefits from the forestry usually outweigh any negative consequences | 1 | 2 | 3 | 4 | 5 | 6 |
| m) Economic stability of communities is more important than setting aside forests from logging | 1 | 2 | 3 | 4 | 5 | 6 |
| n) Forestry practices generally produce few long-term negative effects on the environment | 1 | 2 | 3 | 4 | 5 | 6 |
| o) The citizens of Saskatchewan have enough say in forest management | 1 | 2 | 3 | 4 | 5 | 6 |
| p) Forest management should try to minimize impacts on traditional rural ways of life (ie: hunting and fishing for food) | 1 | 2 | 3 | 4 | 5 | 6 |

# PART II - SASKATCHEWAN FORESTS – CONSIDERING THE OPTIONS

## Forestry in the Boreal Forest

### THE BOREAL FOREST AND THE ROLE OF NATURAL DISTURBANCES

The boreal forest, one of the largest forest ecosystems in the world, has evolved with fire as the main disturbance or force of change and regeneration throughout history. The influence of fire, and to a lesser degree, insects, disease, and wind damage, have changed small and large areas of the forest frequently throughout the past, which has made the boreal forest very 'dynamic' or constantly changing. This dynamic nature is important to realize because the forest will not remain in the same state over time no matter what humans do. Natural disturbance has played a vital role in the boreal forests natural lifecycle and renewal process. Human activities (such as forestry, agriculture, and oil & gas exploration) now affect the landscape on a scale similar to these large natural processes. Therefore it is essential to consider the future possibilities and how the human decisions and actions may contribute to the shaping of the landscape over time. The exercise below tries to understand the human preferences in this process.

### FOREST MANAGEMENT AGREEMENT (FMA)

A Forest Management Agreement (FMA) is a contract between the government and a private corporation (forest companies) to grow, harvest, and establish timber on a sustained yield basis, typically for 20 years.

### TRADE-OFFS INVOLVED IN MAKING CHOICES

The choices in the survey are designed so that the different attributes or characteristics of the forest are represented in a realistic manner. By this we mean that not all the valuable features of a forest can be enjoyed without limit. We make choices based on priorities or highest value and a 'trade off' occurs. For example, if people want more forestry jobs they should understand that less of something else might be the consequence - like less protected areas. This is a more realistic way to make decisions and choose amongst a whole set of options or activities. Therefore, understanding that trade-offs occur, and being more aware of them, is important when making decisions

## Choice Set Instructions

In the following exercise, we would like your opinions about forest resource scenarios. In each case, we would like you to compare the current state of the forest against two possible future scenarios. You will be presented with several sets of future scenarios that examine forestry and wildlife issues in northwestern Saskatchewan (the forest near Meadow Lake, and surrounding area, given the name "NorSask Forest").

Each set of options will be described by attributes such as moose population level; special species; forest age class by percent old; recreation restrictions and forest access; protected areas; direct and indirect employment in the forestry industry; and finally, changes in provincial income taxes per household. Imagine that these scenarios for northwestern Saskatchewan represent the future state of the region and its forest resources. **In each set of three choices, please treat each set as one choice to be made, unrelated to all previous and future sets.** In each case, choose the one option you like the best (or dislike the least) based on your opinion.

We have enclosed a description of the attributes to explain the future scenarios (see following section: Description of Attributes). Please take a few minutes to read the descriptions before completing this section. Take the pullout section of this package to use as a quick reference for the attribute 'levels' when completing the survey.

Some combinations of attributes may not always appear to "make sense" but assume they are possible due to uncertain relationships between some attributes. Try and focus on the task of choosing which option you like the best or dislike the least.

Below is an example of how the scenarios will be presented and how we would like you to indicate which option you prefer. Imagine these choices as different 'futures', some of the attributes are related and some are not. For each of the scenarios presented, we would like you to **select one option**.

Example:

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 7500 Moose | 7500 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 50 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | More than Current Amount (% Old) | Considerably More than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Four-Wheel Drive | Four-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 15% Above Current Amount | Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 610 Jobs | 370 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $85 Decrease in Household taxes/year | $180 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☑ |

## Description of Attributes

The forests of Northwestern Saskatchewan have many different attributes (characteristics or qualities used to identify something). Of these many attributes, only seven are discussed below. Some attributes have been identified, through public consultation, as the most important attributes desired in the present and future forest. Other attributes, such as household income taxes and employment are included to reflect the reality of regional economics and communities that rely on forest resources. These attributes may be described or conceptualized in many different ways including the descriptions below.

### 1) MOOSE POPULATION (UNGULATES):

Ungulates are large hoofed mammals; such as moose, deer, and elk. Moose seek out burned or harvested areas for their favorite food types, which are mostly young aspen, birch, and willow twigs (i.e. browse). All of these plant food sources are dependent on sunlight and therefore grow in open spaces. Fire, clearcutting, and selective harvesting are three different landscape changes but each may increase food sources for the moose. Additionally, a food source must be close to shelter and calving areas for the moose to thrive in an area.

MOOSE POPULATION INFORMATION:

| | | |
|---|---|---|
| Level 1: | **2,000**: | The number of moose corresponding a low density in NW Saskatchewan. |
| Level 2: | **6,000**: | The number of moose corresponding to a low to average density in NW Saskatchewan. |
| Level 3: | **7500**: | The number of moose corresponding to an average to high density in NW Saskatchewan. (current population estimate) |
| Level 4: | **14,000**: | The number of moose corresponding to the highest density in NW Saskatchewan. |

### 2) SPECIAL SPECIES - FOR EXAMPLE CARIBOU

Caribou (also ungulates) – are wide-ranging in the boreal forest, dependent on old growth forests, and are often used as an indicator species for healthy old growth forest and biodiversity. The Woodland Caribou is an at-risk or vulnerable species because of low numbers and sensitivity to human impacts. Population estimates are somewhat uncertain for northwestern Saskatchewan.

Habitat disturbances, such as the construction of forestry roads and forest activity, may increase the number of moose and thus wolves, which further contribute to the decline in caribou. It is important to understand that caribou and moose population numbers usually move in opposite directions due to opposite foraging and habitat preferences.

Woodland Caribou prefer mature forests, which contain large quantities of lichen and are associated with marshes, bogs, lakes and rivers. The reproduction rate of Woodland Caribou is low. Caribou herds have been on the decline for a number of reasons including destruction of habitat, intense hunting (illegal and unintentional - due to misidentification), natural predators such as bears and wolves that attack the young, oil and gas activity (seismic or pipelines), roadkill, and parasites.

WOODLAND CARIBOU POPULATION INFORMATION:

| | | |
|---|---|---|
| Level 1: | **50**: | The chance of continued survival is low. |
| Level 2: | **400**: | The current population level estimate. |
| Level 3: | **600**: | Population level considered necessary to achieve a balance between caribou and their predators. |
| Level 4: | **1,600**: | Historical population level. |

## 3) Forest Age Class - % Old Age Classes ('Old Growth'):

The attribute here is a forest age class mix that tries to deliver the forest shape and structure that allows ecosystem function and habitat required by wildlife.

An age-class distribution is the groups into which the age ranges of trees, forests, stands or forests types is divided for classification The age class and tree species making up the forest largely determines the forest structure (shape and process). The shapes and sizes of stands can be altered for a variety of purposes such as attractive sceneries or controlling animal and pest populations.

A forest is composed of many different age classes. In order to harvest timber and supply the other human values for the forest (while maintaining the most biodiversity and other ecosystem services possible such as clean air and water), forest managers are interested in making available the most appropriate range of age classes. The "correct" or "natural" amount of each age-class is uncertain due to the natural variation in age-class distributions within the boreal forest over time. Hence, public opinion is sought to help determine what is the most appropriate based on both science and the human preference within the recognized randomness or changeability. The different age classes may be represented by the percentage of the forest that is old (for example greater than 80-100 years).

An old forest may be described as containing live and dead trees of various sizes, species, composition, and age class. The snags (dead standing trees) provide cavities and food for many different birds and mammals while the fallen logs are sources of shelter and future soil. Many insects and microorganism also rely on decaying wood material. These organisms recycle nutrients and form the basis for all life. Old age-classes are seldom abundant relative to young and mature forests because they take so long to develop and therefore are subject to many threats over their lifetime (e.g. fire, disease). Hence, they are often located in areas that have not been (or are not as likely to be) naturally disturbed for long periods of time.

Conifers (trees that have cones e.g. Spruce) in the boreal forest may be considered old if they are older than 100 yrs whereas deciduous trees such as Aspen over 80 years of age may be considered old. If the amount of old forest becomes too old or too large, it may or may not become even more vulnerable to fire and burn.

### FOREST AGE CLASS INFORMATION:

Level 1: **Less than Current Amount of OLD Forest**
% "Aspen" greater than 80 yrs --> 5% % "Conifers" greater than 100 yrs --> 15%

Level 2: **Current Amount of OLD Forest**
% "Aspen" greater than 80 yrs --> 9% % "Conifers" greater than 100 yrs --> 22%

Level 3: **More than Current Amount of OLD Forest**
% "Aspen" greater than 80 yrs --> 12% % "Conifers" greater than 100 yrs --> 25 %

Level 4: **Considerably more than Current Amount of OLD Forest**
% "Aspen" greater than 80 yrs --> 15% % "Conifers" greater than 100 yrs --> 35%

### 4) RECREATION RESTRICTIONS AND FOREST ACCESS:

The number of roads into a forested area affects the biodiversity by changing the habitat, fragmenting (or breaking up the forest), and allowing increasing numbers of people to a site or area (different degrees of human congestion).

Increased access often brings increased recreational opportunities. Some possible low impact activities are cross-country skiing, wild berry picking, and hiking and camping. Other forms of activity with greater impacts on wildlife and habitat may include off-road recreation vehicles (ATV's and snowmobiles) and hunting (subsistence and outfitting) to an area.

Forestry roads are initially constructed to facilitate harvest operations, maintain silviculture activities (planting and thinning of trees), and controlling fires.

Road density and road design is an issue related to water quality, fish numbers and human access. Stream crossing and a high-density road complex are associated with increased erosion, the silting and degradation of water quality, and fish migration and populations. The amount of effort is linked to access. The less effort required arriving at a location the greater the access. Deliberate efforts may be taken to close some roads to protect wildlife.

The amount and intensity of recreational activity may range from unrestricted recreation activities to restricted.

RECREATION RESTRICTIONS AND FOREST ACCESS INFORMATION:

Level 1: **Two-wheel drive (2WD) access** (i.e. any car may drive into area). Hunting and fishing allowed; off-road vehicles, horses, helicopters and overnight camping allowed. Unrestricted.

Level 2: **Four-wheel drive (4WD) required to access area** (i.e. trucks with greater clearance); Hunting and fishing allowed; off-road vehicles, horses, and helicopters but overnight camping allowed only in designated areas.

Level 3: **All terrain vehicles (ATV) are required to access area** (i.e. challenging quad or snowmobile riding); Areas developed with restrictions on hunting and fishing (e.g. limited entry hunting draw, catch and release fishing) horses and overnight camping in designated areas.

Level 4: **Foot access only** (i.e. walking or hiking); restrictions on hunting and fishing (e.g. limited entry hunting draw, catch and release fishing) horses and overnight camping in designated areas. No off-road vehicles, reduced speed limits on highways in the area, no horses, no helicopters, walking and hiking only on designated trails, and limited access to overnight camping (permits required).

Note: There would be no change to the present rights of Aboriginal Peoples in regards to land use in this representation.

### 5) PROTECTED AREA:

**Protected Areas** - areas set aside from present harvesting activity. These may act as benchmarks or reference points for comparative research and education (i.e. long-term monitoring and provide a scientific basis for adjusting land-use planning and processes that support the diversity of species, ecosystems and landscapes found in Saskatchewan) and provide a source or bank of ecological material (i.e. biodiversity).

These may come in the form of large buffers along streams and lakes; fur buffers; sacred and spiritual ground buffers and wide buffers around First Nation communities as well as around wildlife corridors (forest connectivity for wildlife to travel across landscapes) and calving/wintering habitat.

The Northwestern Saskatchewan Forest (NorSask) FMA has a Core Area of approximately 1.7 million hectares. Of this area, approximately 46% is 'productive forest' (forest that may be harvested) and thus approximately 54% of the core area will not be harvested. Additionally, some other parts of the productive forest landbase (estimated to be 2 to 3%) will also not be harvested due to remoteness, biodiversity, heritage, cultural, riparian, and aesthetic values. Therefore, approximately 43 to 44% of the total core landbase area may be subject to harvesting activity in the foreseeable future and the current amount left unharvested is 56 to 57%.

Note: Currently, Mistik Management maintains some 'protected areas' required by harvest regulations (for example watercourse buffers). Additionally, other buffer zones exist around calving areas, trap lines, sacred sites and First Nations communities as deemed important through co-management boards.

The levels below refer to Protected Area above the current protection (either by regulations or voluntarily by co-management board suggestions).

PROTECTED AREAS INFORMATION:

Level 1: **Current Amount**

Level 2: **5% Above Current Amount**

Level 3: **10% Above Current Amount**

Level 4: **15% Above Current Amount**

### 6) DIRECT AND INDIRECT FOREST INDUSTRY EMPLOYMENT:

This attribute refers to the number of direct and indirect jobs in Meadow Lake and surrounding areas the Northwestern Saskatchewan Forest (NorSask).

**Direct forestry jobs** may be in: management, sawmill or pulp mill, field contractors that harvest and transport the logs, tree-planters, silviculture, etc.

**Indirect forestry jobs** are the jobs that are generated due to the primary industry. In this case the forest sector. These would be businesses that supply the required goods and services to the people employed in forestry.

### 7) ANNUAL PROVINCIAL HOUSEHOLD INCOME TAX CHANGES:

The Provincial Government acquires revenue from forest industry activities through taxes on wood volumes, taxes on labour income, and taxes on profits.

**Tax levels may increase** because of lower revenues to the province and money may be required for retraining and relocation of workers: increased costs of management of wilderness areas, intensive management of wildlife species like woodland caribou, and possibly increased costs of management of recreation activities.

**Tax levels may decrease** if additional revenues are generated (from forestry, other industrial activity such as mining or oil and gas development, or recreation and tourism).

Note: In all your choices assume water quality (low road density, bridges, winter roads, minimize sediment loads into waterways), traplines, and understory protection, (such as berries and medicinal plants) **remain constant** and that the best available science and practices will be applied to them.

**TAKE THE ATTRIBUTE QUICK REFERENCE PAGE (FOUND HERE)
TO USE AS A QUICK REFERENCE FOR THE ATTRIBUTE 'LEVELS' WHEN COMPLETING THE SURVEY.**

**PLEASE CONSIDER EACH SCENARIO AS
INDEPENDENT AND UNRELATED TO ANY OTHER SCENARIOS.**

Set 1

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Foot Access Only | Four-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 15% Above Current Amount | 5% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 590 Jobs | 620 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

When you made your selection in Set 1 did you feel that your choice in relation to the other options was (please circle one number):

| ONLY SLIGHTLY BETTER | | SOMEWHAT BETTER | | MUCH BETTER |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

Set 2

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 7500 Moose | 7500 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 400 Caribou | 50 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Current Amount (% Old) | Less than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Four-Wheel Drive | ATV Required |
| **PROTECTED AREAS (%)** | Current Amount | 15% Above Current Amount | 15% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 315 Jobs | 345 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $140 Increase in Household taxes/year | $60 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 3

| ATTRIBUTES OF FOREST REGION | OPTION ONE CURRENT SITUATION | OPTION TWO ALTERNATIVE SITUATION | OPTION THREE ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 6000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 50 Caribou | 400 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | More than Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Four-Wheel Drive | Four-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 5% Above Current Amount | 5% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 570 Jobs | 460 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $70 Decrease in Household taxes/year | $15 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 4

| ATTRIBUTES OF FOREST REGION | OPTION ONE CURRENT SITUATION | OPTION TWO ALTERNATIVE SITUATION | OPTION THREE ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 7500 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 1600 Caribou | 600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Less than Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | ATV Required | Four-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 10% Above Current Amount | 5% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 500 Jobs | 720 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $50 Increase in Household taxes/year | $15 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 5

| ATTRIBUTES OF FOREST REGION | OPTION ONE CURRENT SITUATION | OPTION TWO ALTERNATIVE SITUATION | OPTION THREE ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 6000 Moose | 2000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 50 Caribou | 400 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | More than Current Amount (% Old) | More than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | ATV Required | Foot Access Only |
| **PROTECTED AREAS (%)** | Current Amount | 15% Above Current Amount | Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 505 Jobs | 470 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $90 Decrease in Household taxes/year | $65 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 6

| ATTRIBUTES OF FOREST REGION | OPTION ONE CURRENT SITUATION | OPTION TWO ALTERNATIVE SITUATION | OPTION THREE ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 7500 Moose | 2000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 1600 Caribou | 600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Less than Current Amount (% Old) | Less than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Foot Access Only | ATV Required |
| **PROTECTED AREAS (%)** | Current Amount | 5% Above Current Amount | 15% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 580 Jobs | 325 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $95 Increase in Household taxes/year | $185 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 7

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>Current Situation | OPTION TWO<br>Alternative Situation | OPTION THREE<br>Alternative Situation |
|---|---|---|---|
| **Moose (Ungulates)** | 7500 Moose | 6000 Moose | 7500 Moose |
| **Special Species** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **Forest Age Class (% Old)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | More than Current Amount (% Old) |
| **Recreation Restrictions & Forest Age Class** | Two-Wheel Drive | Two-Wheel Drive | Foot Access Only |
| **Protected Areas (%)** | Current Amount | 5% Above Current Amount | Current Amount |
| **Forest Industry Employment** | 600 Jobs | 695 Jobs | 485 Jobs |
| **Provincial Household Income Tax Change** | No change in Household taxes/year | $25 Increase in Household taxes/year | $90 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **Preferred Option:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 8

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>Current Situation | OPTION TWO<br>Alternative Situation | OPTION THREE<br>Alternative Situation |
|---|---|---|---|
| **Moose (Ungulates)** | 7500 Moose | 14 000 Moose | 14 000 Moose |
| **Special Species** | 400 Caribou | 400 Caribou | 50 Caribou |
| **Forest Age Class (% Old)** | Current Amount (% Old) | Current Amount (% Old) | Considerably More than Current Amount (% Old) |
| **Recreation Restrictions & Forest Age Class** | Two-Wheel Drive | ATV Required | Two-Wheel Drive |
| **Protected Areas (%)** | Current Amount | 5% Above Current Amount | 10% Above Current Amount |
| **Forest Industry Employment** | 600 Jobs | 420 Jobs | 550 Jobs |
| **Provincial Household Income Tax Change** | No change in Household taxes/year | $110 Increase in Household taxes/year | $10 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **Preferred Option:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 9

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 7500 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 50 Caribou | 400 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | More than Current Amount (% Old) | Less than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Two-Wheel Drive | ATV Required |
| **PROTECTED AREAS (%)** | Current Amount | 10% Above Current Amount | 15% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 365 Jobs | 270 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $45 Decrease in Household taxes/year | $145 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 10

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 2000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 400 Caribou | 50 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Two-Wheel Drive | Four-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | Current Amount | 5% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 580 Jobs | 380 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $55 Decrease in Household taxes/year | $75 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 11

| ATTRIBUTES OF FOREST REGION | OPTION ONE CURRENT SITUATION | OPTION TWO ALTERNATIVE SITUATION | OPTION THREE ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 7500 Moose | 6000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Less than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | ATV Required | ATV Required |
| **PROTECTED AREAS (%)** | Current Amount | Current Amount | 15% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 420 Jobs | 385 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $10 Increase in Household taxes/year | $205 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 12

| ATTRIBUTES OF FOREST REGION | OPTION ONE CURRENT SITUATION | OPTION TWO ALTERNATIVE SITUATION | OPTION THREE ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 6000 Moose | 6000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 400 Caribou | 50 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Current Amount (% Old) | More than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Foot Access Only | Foot Access Only |
| **PROTECTED AREAS (%)** | Current Amount | 10% Above Current Amount | Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 330 Jobs | 750 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $110 Increase in Household taxes/year | $40 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 13

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 14 000 Moose | 7500 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 50 Caribou | 400 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | More than Current Amount (% Old) | Considerably More than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Foot Access Only | Two-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | Current Amount | 10% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 630 Jobs | 605 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $35 Increase in Household taxes/year | $95 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 14

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 6000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 1600 Caribou | 600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Less than Current Amount (% Old) | More than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Four-Wheel Drive | Foot Access Only |
| **PROTECTED AREAS (%)** | Current Amount | Current Amount | Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 535 Jobs | 560 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $55 Increase in Household taxes/year | $35 Increase in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 15

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 14 000 Moose | 2000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Considerably More than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Four-Wheel Drive | Two-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 10% Above Current Amount | 10% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 570 Jobs | 500 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $5 Decrease in Household taxes/year | $10 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Set 16

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 14 000 Moose | 6000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 1600 Caribou | 600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Less than Current Amount (% Old) | Considerably More than Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Two-Wheel Drive | Two-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 15% Above Current Amount | 10% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 530 Jobs | 575 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $60 Decrease in Household taxes/year | No Change in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

## PART IV

The types of questions that you completed in the previous section are a relatively new method of learning about the public's preference for aspects of forest management. Therefore in order to understand the usefulness or this tool we would appreciate your help by answering the following questions concerning previous knowledge and the level of difficulty.

| | TOTALLY DISAGREE | PARTLY DISAGREE | NEITHER AGREE NOR DISAGREE | PARTLY AGREE | TOTALLY AGREE |
|---|---|---|---|---|---|
| 1. It took me a long time to decide what to choose. | 1 | 2 | 3 | 4 | 5 |
| 2. I feel that too much effort was required to make the choices. | 1 | 2 | 3 | 4 | 5 |
| 3. I found the choice from three options to be confusing. | 1 | 2 | 3 | 4 | 5 |
| 4. I found choosing from the three options to be frustrating. | 1 | 2 | 3 | 4 | 5 |
| 5. I found it difficult to choose one option. | 1 | 2 | 3 | 4 | 5 |
| 6. There were too many sets of choices to make. | 1 | 2 | 3 | 4 | 5 |

7. How familiar are you with forestry in Saskatchewan?

    a. Completely Unfamiliar (was unaware of forestry in Saskatchewan)
    b. Somewhat Unfamiliar (heard mention of forestry in Saskatchewan)
    c. Somewhat Familiar (know it exists but do not think about it often)
    d. Completely Familiar (think or read or talk of it often)

## PART V - INFORMATION ABOUT YOU

These questions will help determine if there are connections between peoples backgrounds and their opinions. Your name will not be associated with the answers however if there is a question you do not want to answer, just leave it blank and proceed to the next question.

1. GENDER: MALE ☐ FEMALE ☐

2. AGE: ______ YEARS

3. Do you belong to the one of the following organizations?

| | **Yes** | **No** |
|---|---|---|
| a. A natural history or birdwatching club | ☐$_1$ | ☐$_2$ |
| b. A hunting or fishing organization | ☐$_1$ | ☐$_2$ |
| c. Other environmental or conservation organizations | ☐$_1$ | ☐$_2$ |

4. Does anyone in your household depend upon the forest, mining, oil and gas industries, or a natural resource agency for their economic livelihood?

YES ☐$_1$ No ☐$_2$

5. What is the highest level of education that you have completed?

☐$_1$ Never attended school
☐$_2$ Grade school (grades 1 to 9)
☐$_3$ Some high School
☐$_4$ High school graduate
☐$_5$ Technical school or community college
☐$_6$ Some University
☐$_7$ University degree (Bachelors)
☐$_8$ Some Graduate studies
☐$_9$ Graduate University Degree

6. Which Category best describes your total household income (before taxes) in 1999?

☐$_1$ less than $ 10,000
☐$_2$ $ 10 – $ 19,999
☐$_3$ $ 20 – $ 29,999
☐$_4$ $ 30 – $ 39,999
☐$_5$ $ 40 – $ 49,999
☐$_6$ $ 50 – $ 59,999
☐$_7$ $ 60 – $ 69,999
☐$_8$ $ 70 – $79,999
☐$_9$ $ 80 – $ 89,999
☐$_{10}$ $ 90 – $ 99,999
☐$_{11}$ $ 100,000 or more

7. Do you participate in any of the following activities in Saskatchewan Forests? (Check all that apply)

☐ Camping
☐ Hiking/walking
☐ Birdwatching
☐ Viewing other wildlife
☐ Backpacking
☐ Snowmobiling
☐ Quadding, ATVing, dirt biking
☐ Horseback riding
☐ Mountain biking
☐ Cross country skiing
☐ Canoeing, rafting, or boating
☐ Hunting
☐ Fishing
☐ Other ______________________

Do you believe present forest management in Saskatchewan is sustainable? Why or Why not?

Do you have any other values or sentiments toward the boreal forest in NW Saskatchewan?

If you have any additional comments about either survey or the public involvement process please use the space provided below, the reverse side or attach a page. Your name will not be associated with the comments if they are published as part of any report.

Thank you for taking the time to complete this survey.

## Appendix B : $L_7$, $U_7$, $L_{5+2}$, $U_{5+2}$, $L_5$, $U_5$ Task Examples

Version $L_7$

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Foot Access Only | Four-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 15% Above Current Amount | 5% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 590 Jobs | 620 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Version $U_7$

| ATTRIBUTES OF FOREST REGION | OPTION ONE | OPTION TWO | OPTION THREE |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Foot Access Only | Four-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | 15% Above Current Amount | 5% Above Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 590 Jobs | 620 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Version $L_{5+2}$

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Two-Wheel Drive | Two-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | Current Amount | Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 590 Jobs | 620 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Version $U_{5+2}$

| ATTRIBUTES OF FOREST REGION | OPTION ONE | OPTION TWO | OPTION THREE |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| **RECREATION RESTRICTIONS & FOREST AGE CLASS** | Two-Wheel Drive | Two-Wheel Drive | Two-Wheel Drive |
| **PROTECTED AREAS (%)** | Current Amount | Current Amount | Current Amount |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 590 Jobs | 620 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Version L5

| ATTRIBUTES OF FOREST REGION | OPTION ONE<br>CURRENT SITUATION | OPTION TWO<br>ALTERNATIVE SITUATION | OPTION THREE<br>ALTERNATIVE SITUATION |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 590 Jobs | 620 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |

Version U5

| ATTRIBUTES OF FOREST REGION | OPTION ONE | OPTION TWO | OPTION THREE |
|---|---|---|---|
| **MOOSE (UNGULATES)** | 7500 Moose | 2000 Moose | 14 000 Moose |
| **SPECIAL SPECIES** | 400 Caribou | 600 Caribou | 1600 Caribou |
| **FOREST AGE CLASS (% OLD)** | Current Amount (% Old) | Considerably More than Current Amount (% Old) | Current Amount (% Old) |
| **FOREST INDUSTRY EMPLOYMENT** | 600 Jobs | 590 Jobs | 620 Jobs |
| **PROVINCIAL HOUSEHOLD INCOME TAX CHANGE** | No change in Household taxes/year | $120 Decrease in Household taxes/year | $15 Decrease in Household taxes/year |

| | | | |
|---|---|---|---|
| **PREFERRED OPTION:** (Check one box) | 1 ☐ | 2 ☐ | 3 ☐ |